POSTED 4E96600F

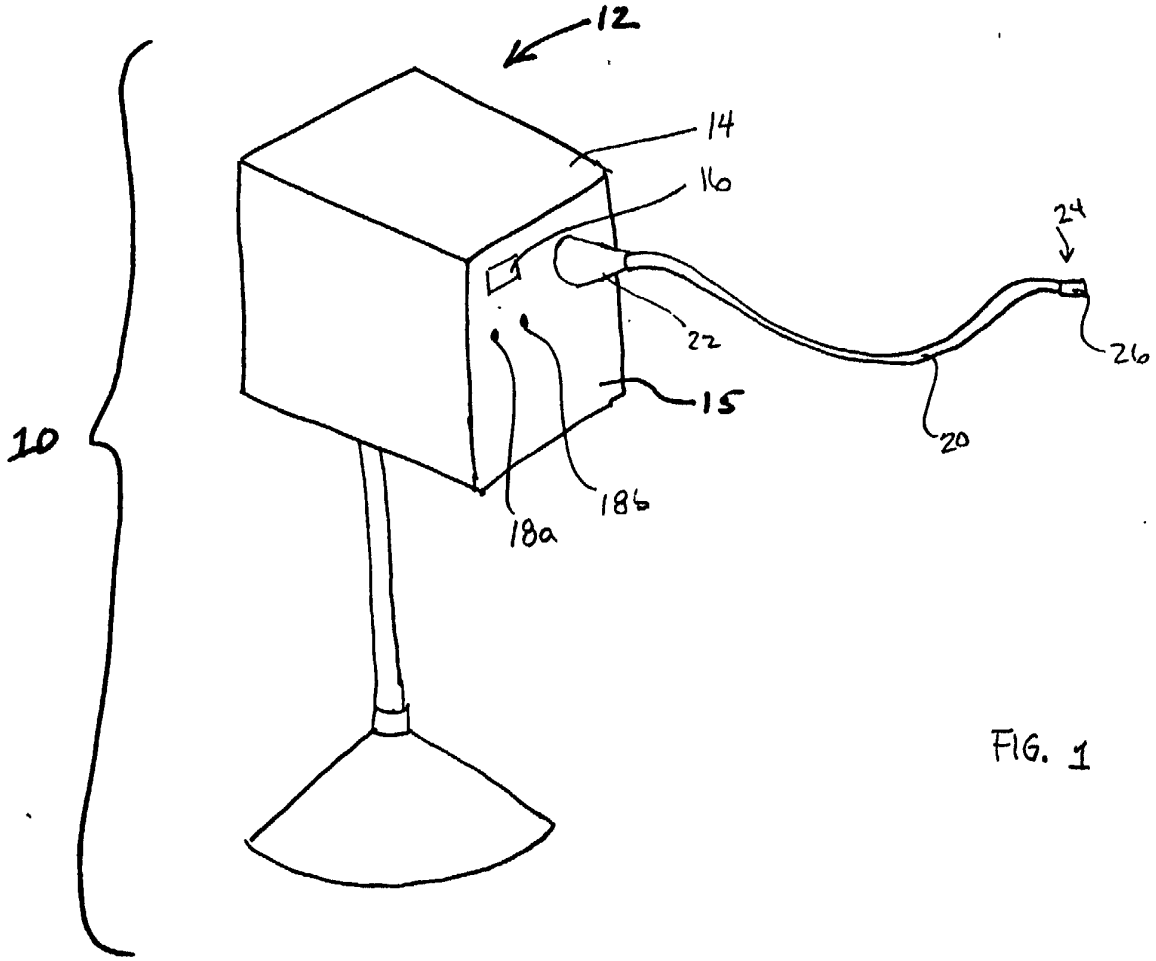


FIG. 1

20STED "AE966DOT

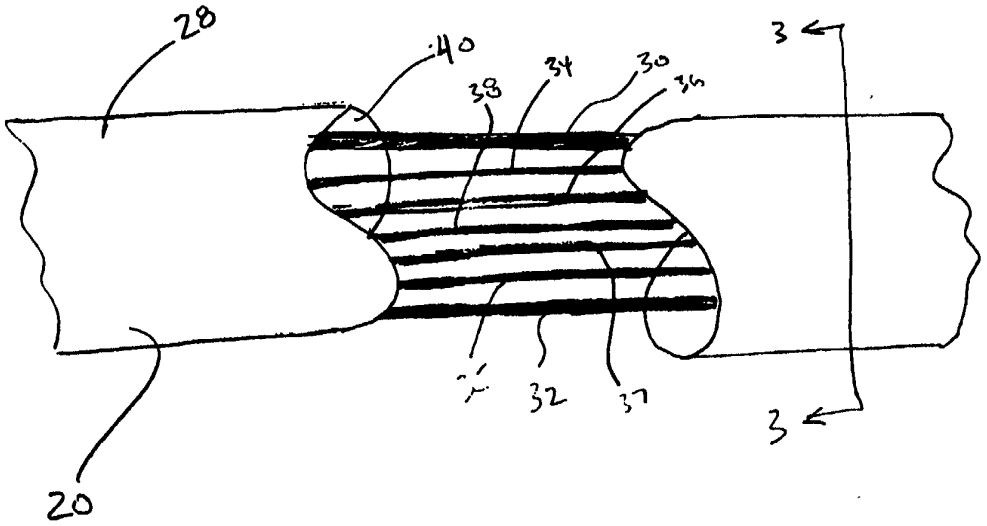


FIG. 2

PATENT DRAWING

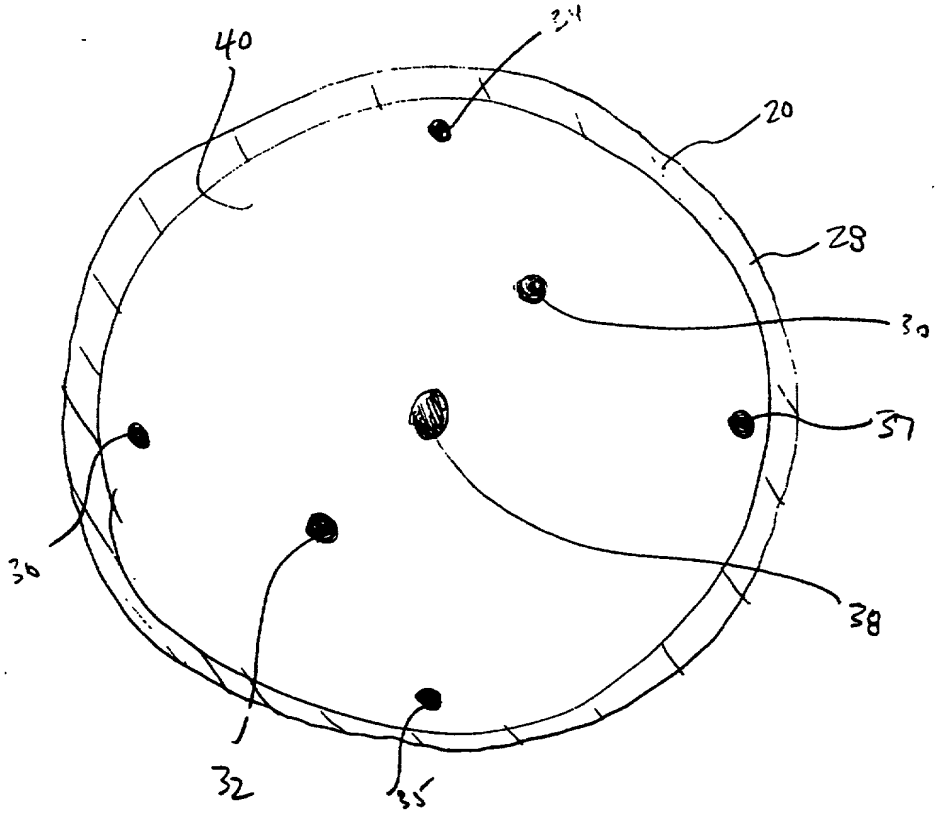


FIG. 3

Patented Feb 25, 2003

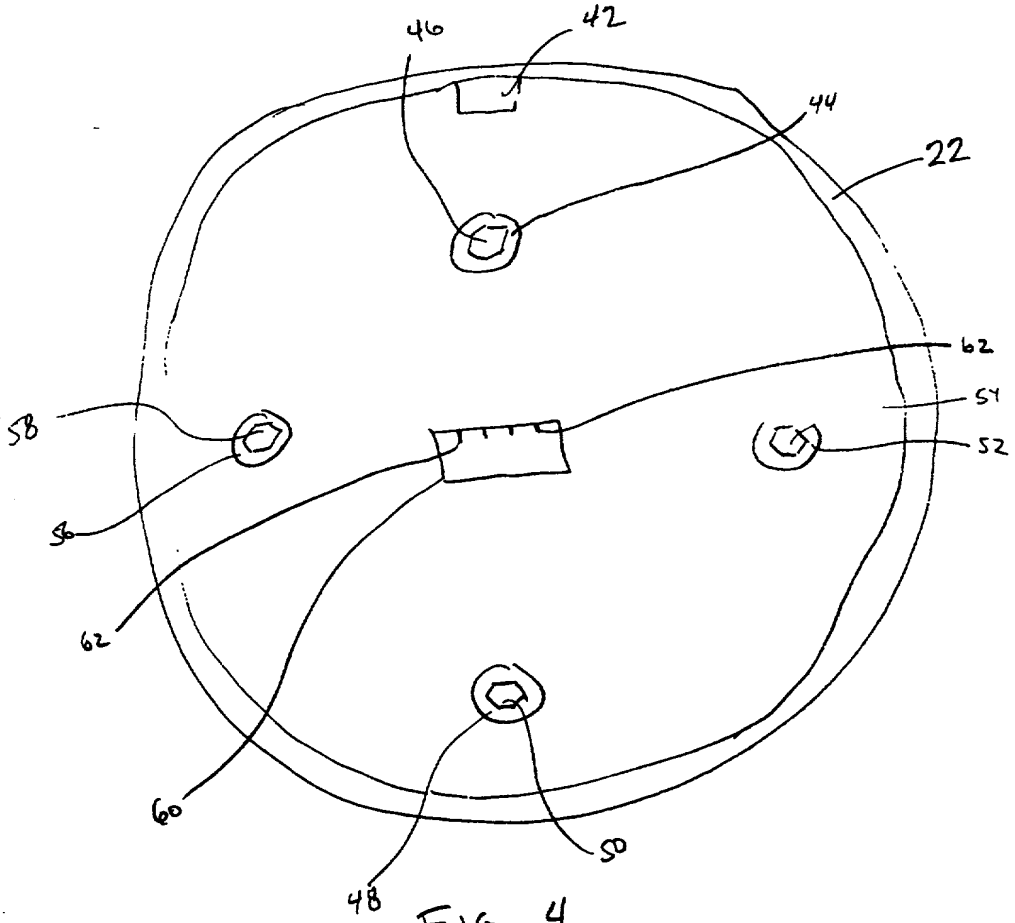


FIG. 4

Case No. 12-2-00004-4

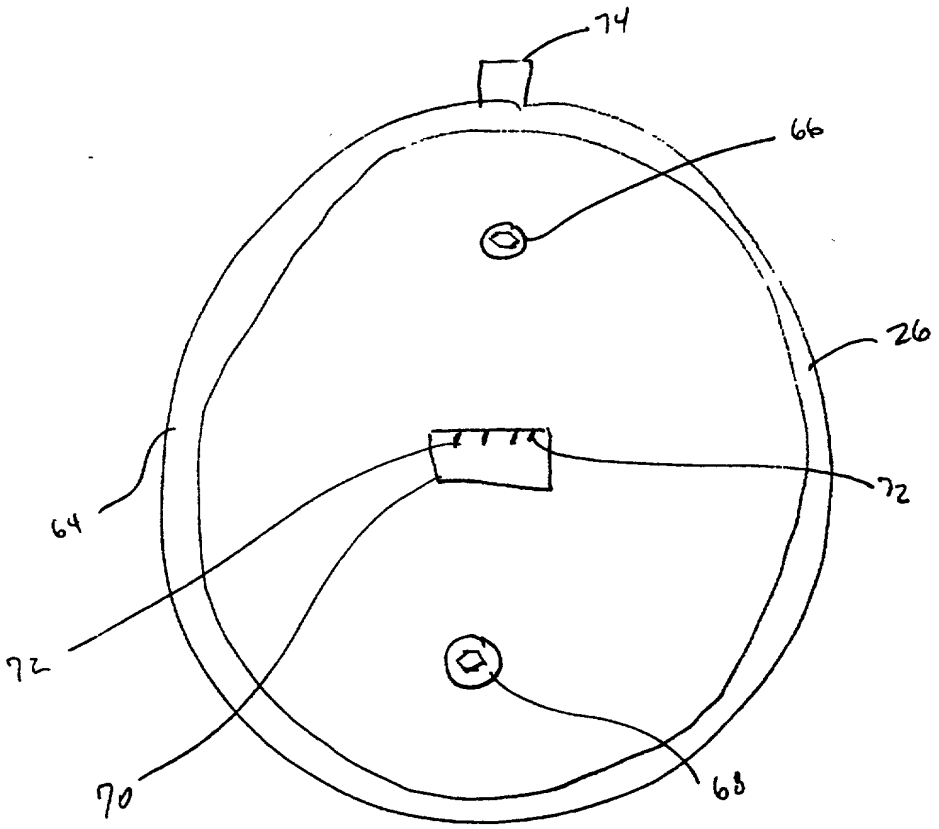


FIG. 5

POSTED 4/25/2007

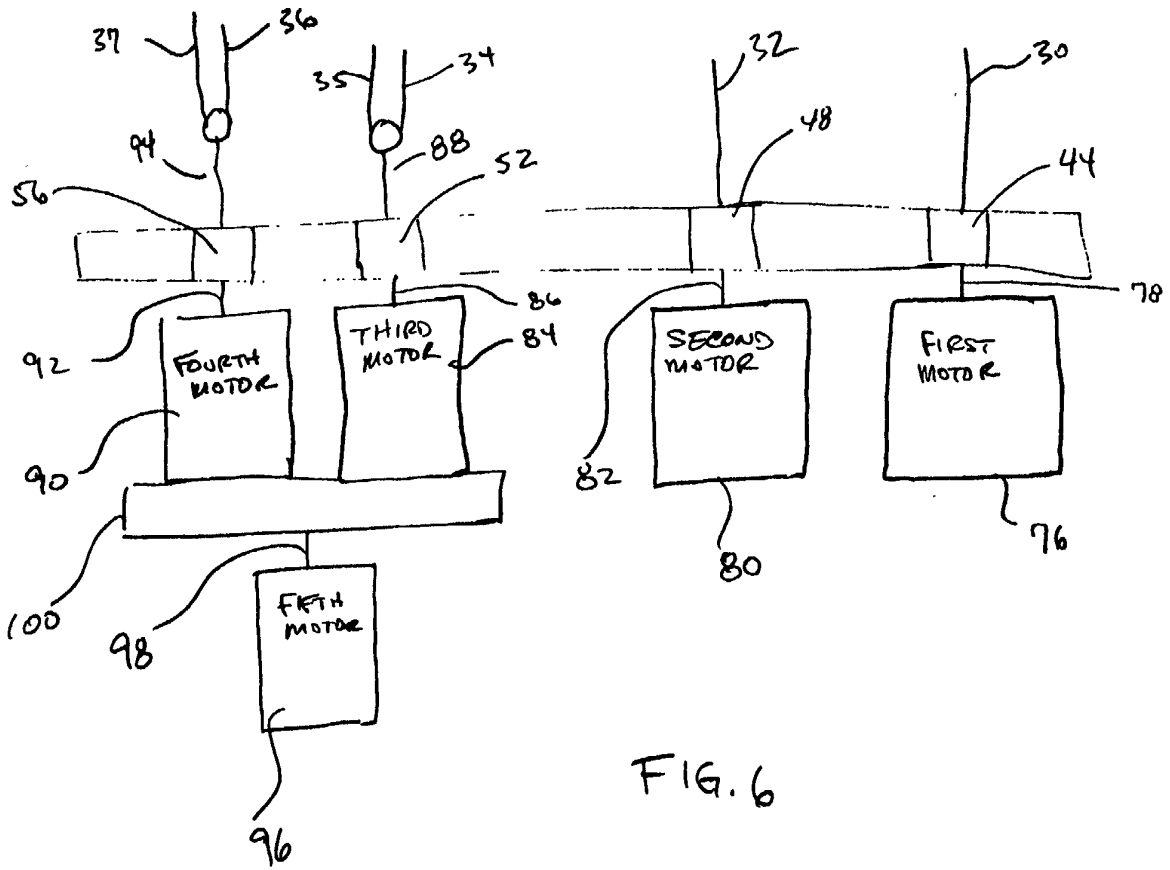


FIG. 6

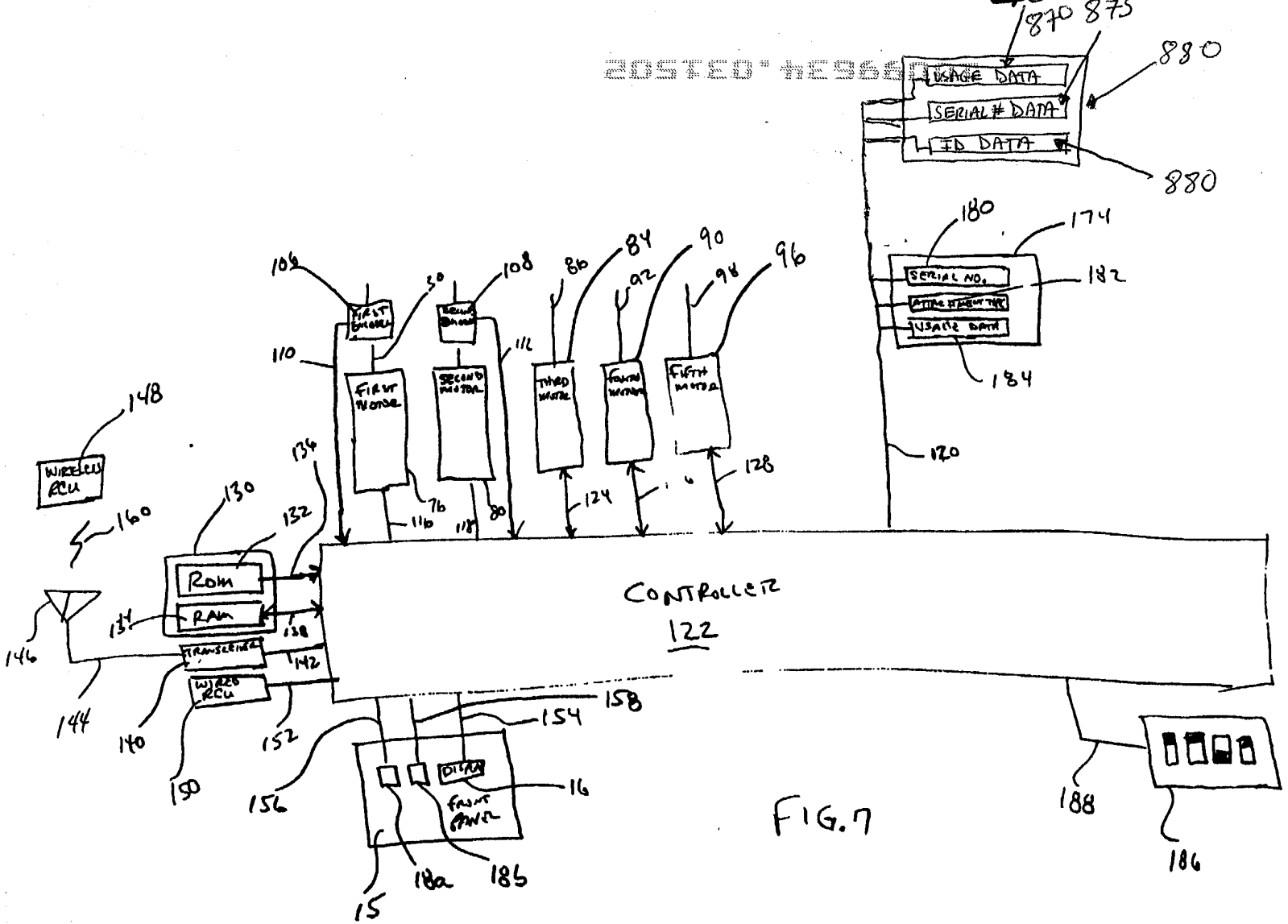

USAGE DATA
SERIAL # DATA
ID DATA
870
875
880
880
180
174
SERIAL NO.
182
184
120
CONTROLLER
122
ROM
RAM
TRANSCEIVER
WIRELESS RCU
148
160
146
144
140
150
152
130
132
134
136
138
142
158
154
156
16
18a
185
15
188
186
124
126
128
110
112
114
116
118
76
80
84
86
90
92
94
96
104
108

FIG. 7

POSTED 4E96600F

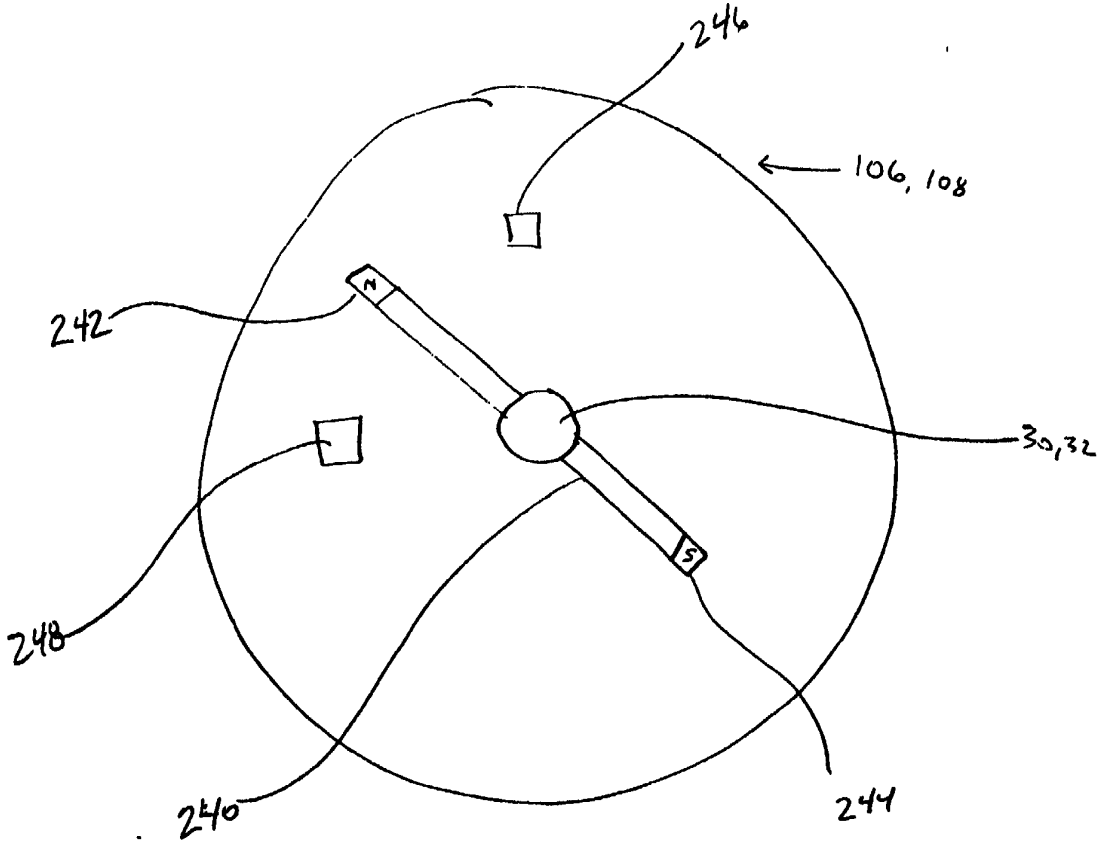


Fig. 8

2057ED "AE9660GT

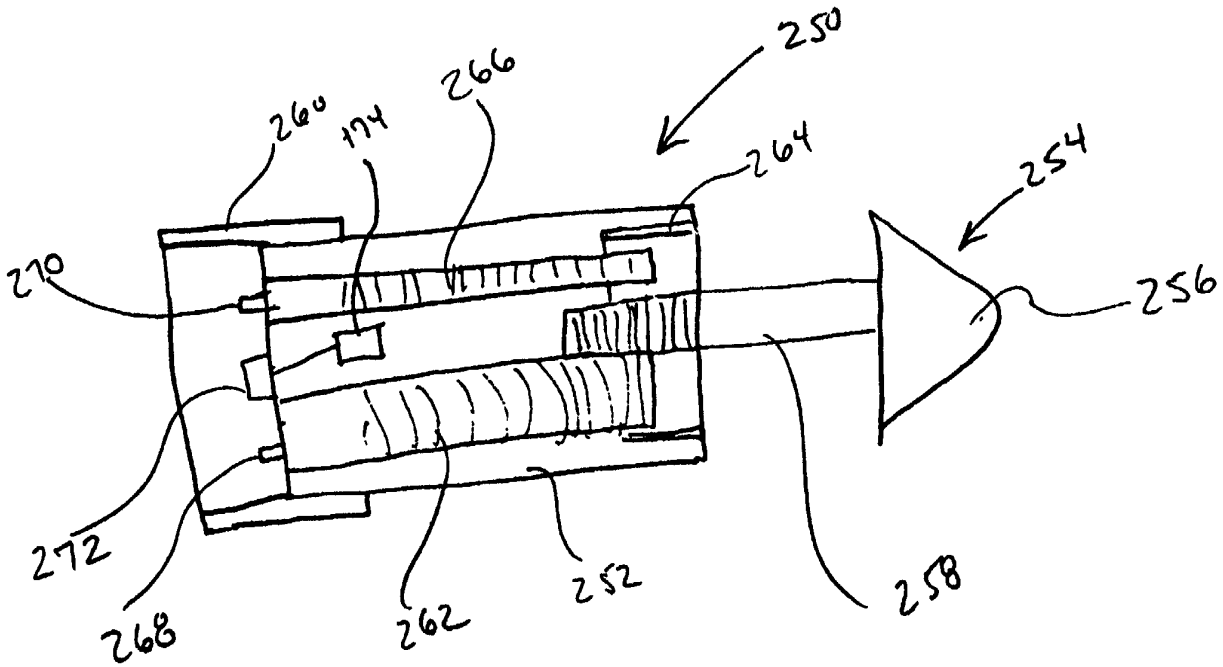


Fig. 9A

POSTED: 06/30/2007

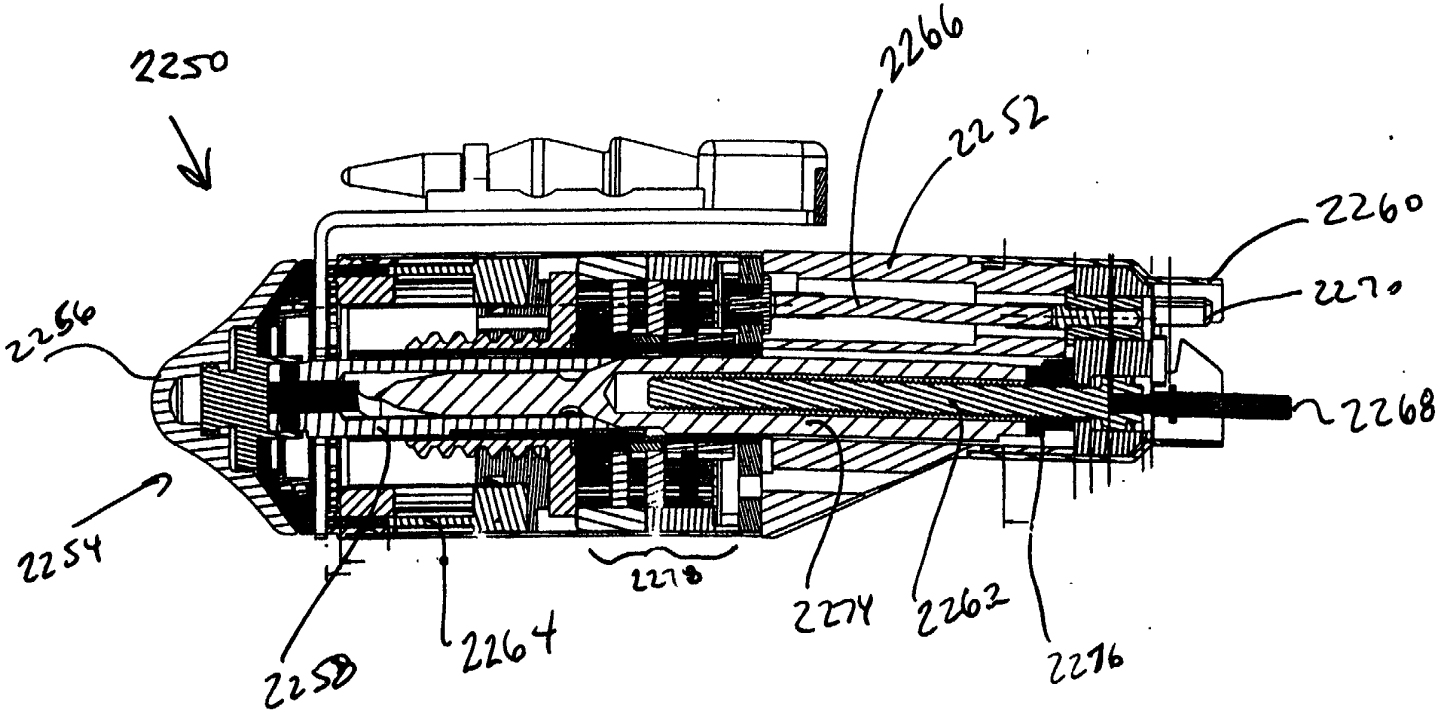


FIGURE 9B

Application Number

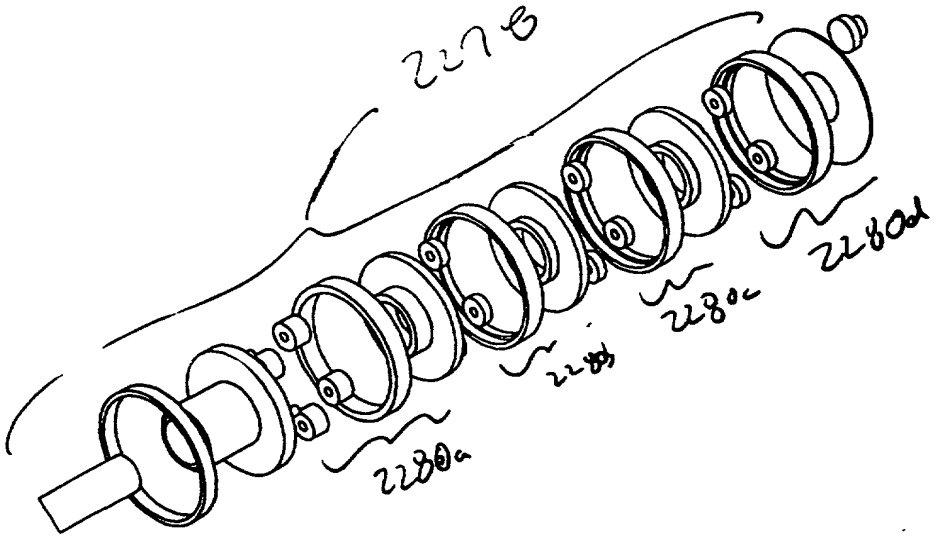


FIG. 9C

POSTED 06/30/2003

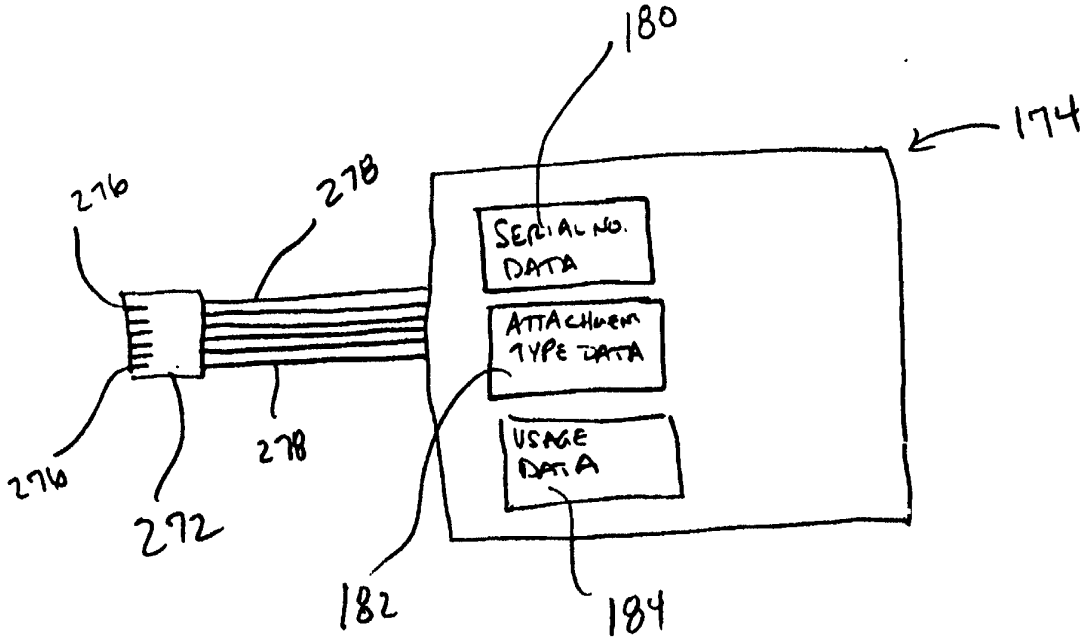


FIG. 10

POSTED 4/29/2008

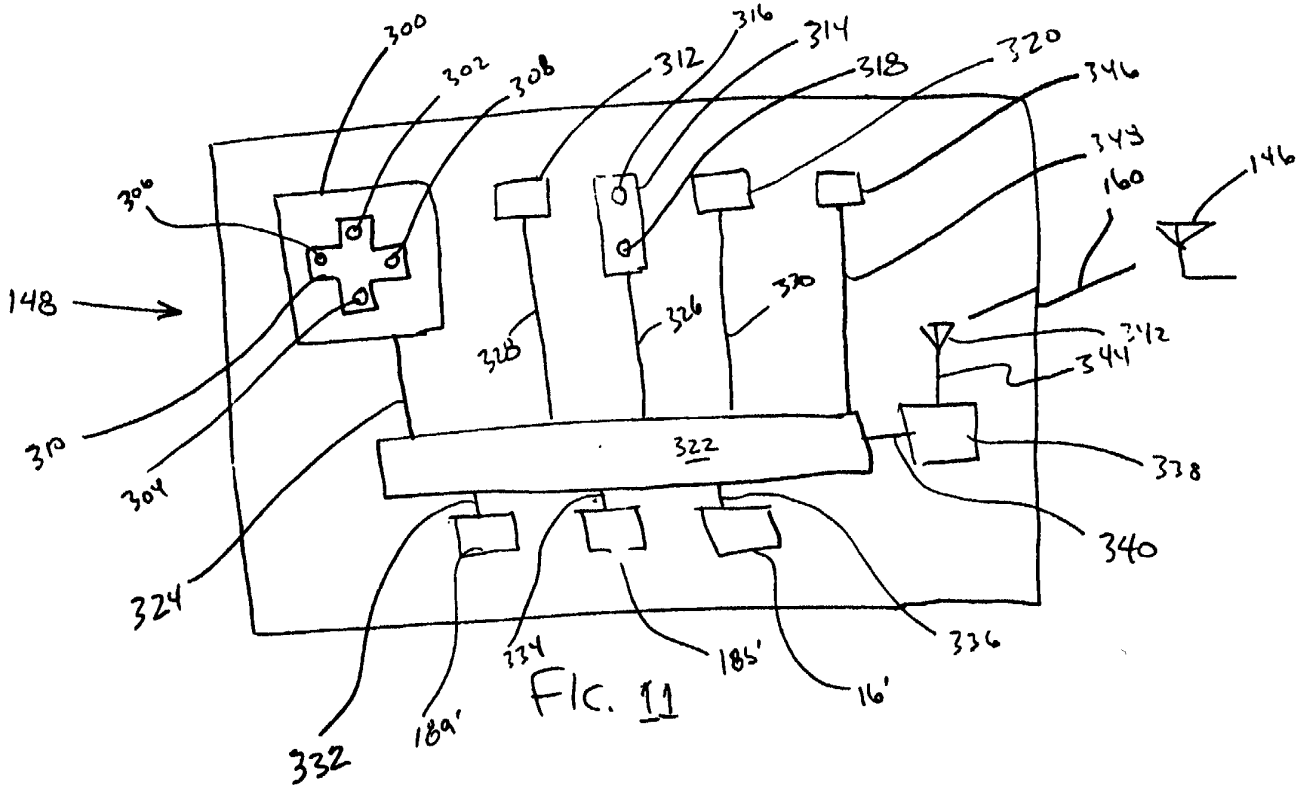


FIG. 11

20STED "AE966007

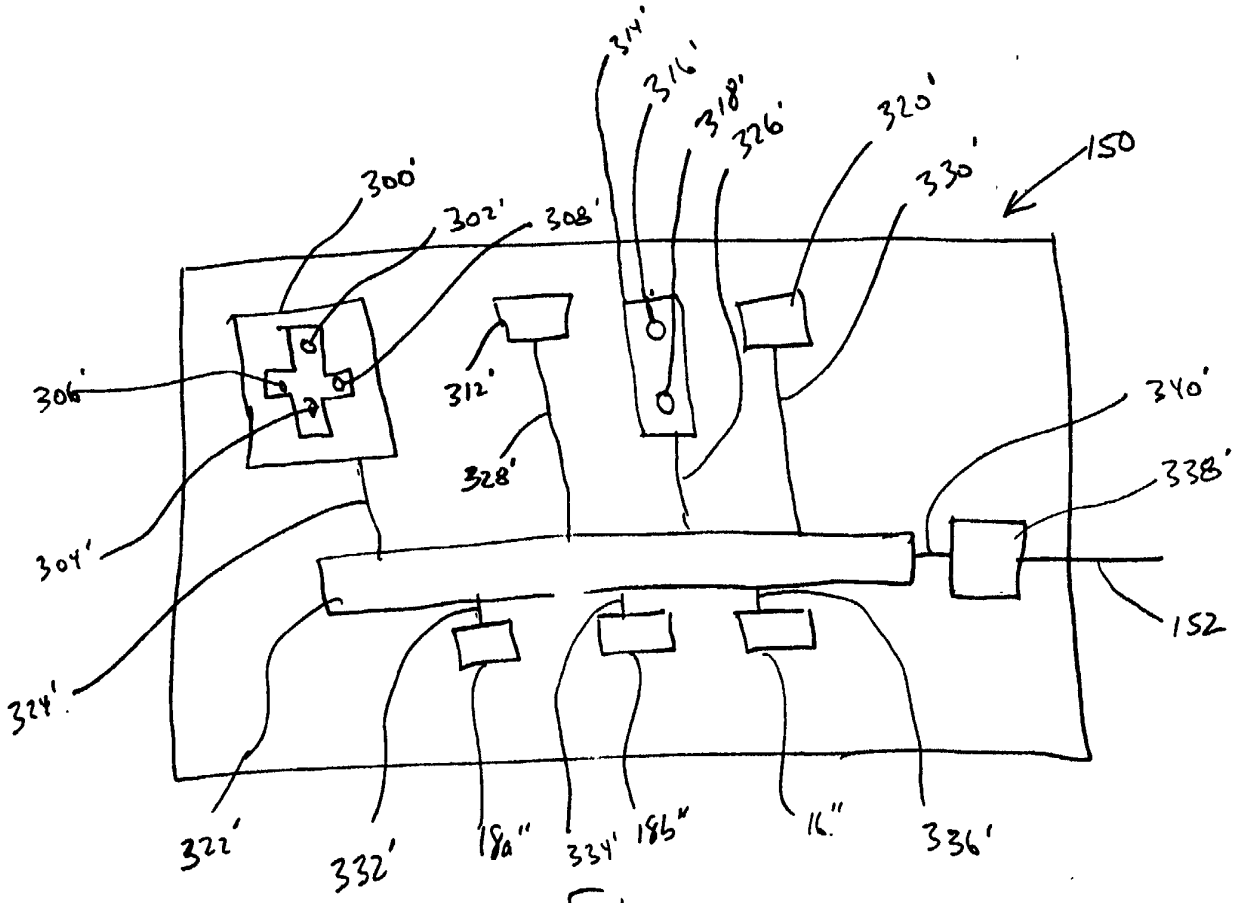


FIG. 12

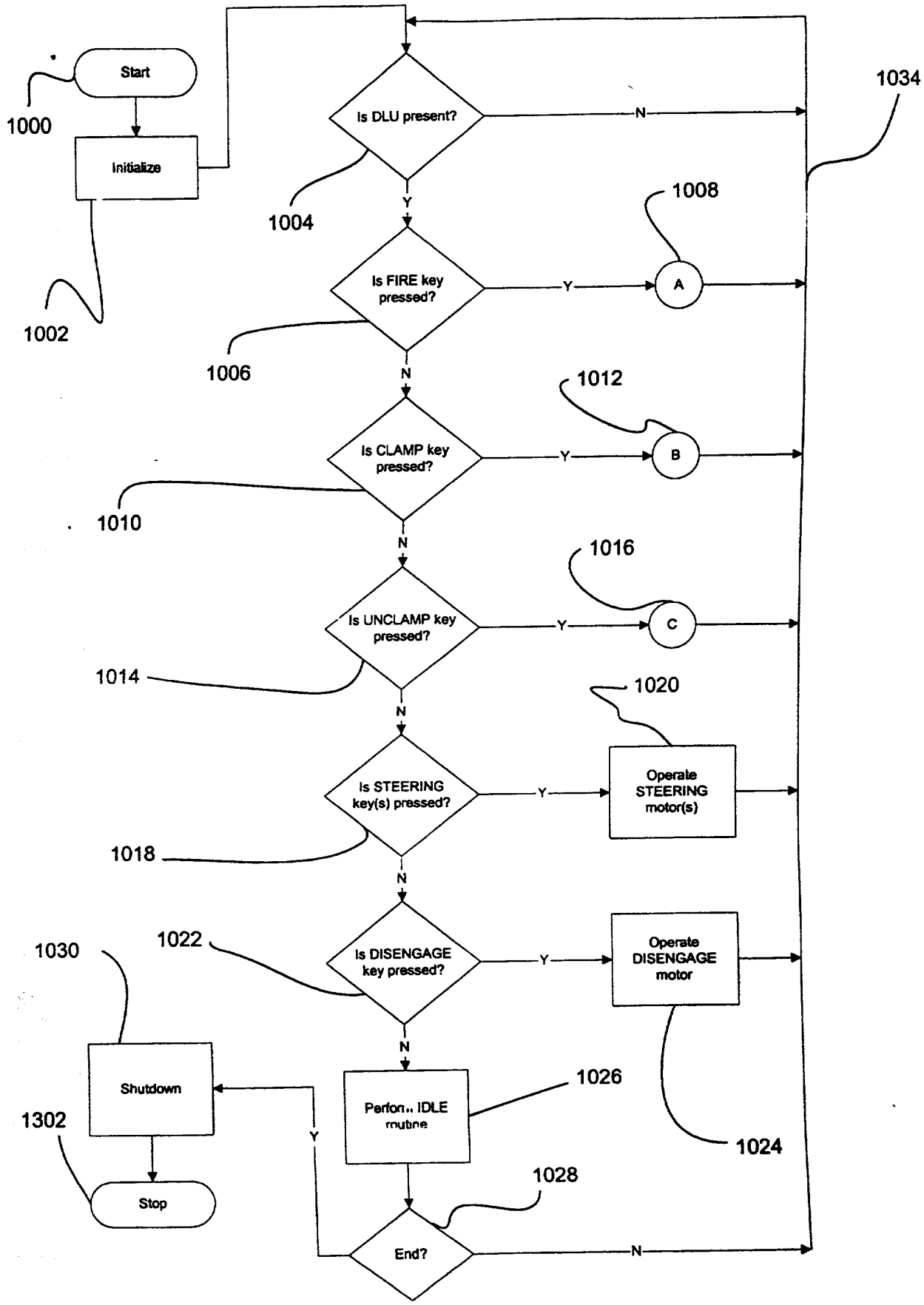

Start
1000
Initialize
1002
Is DLU present?
N
1034
1004
Y
1008
Is FIRE key pressed?
Y
A
1006
N
1012
Is CLAMP key pressed?
Y
B
1010
N
1016
Is UNCLAMP key pressed?
Y
C
1014
N
1020
Is STEERING key(s) pressed?
Y
Operate STEERING motor(s)
1018
N
1022
Is DISENGAGE key pressed?
Y
Operate DISENGAGE motor
1030
1024
N
Shutdown
Perfon.. IDLE
1026
1302
Y
Stop
1028
End?
N

Figure 13

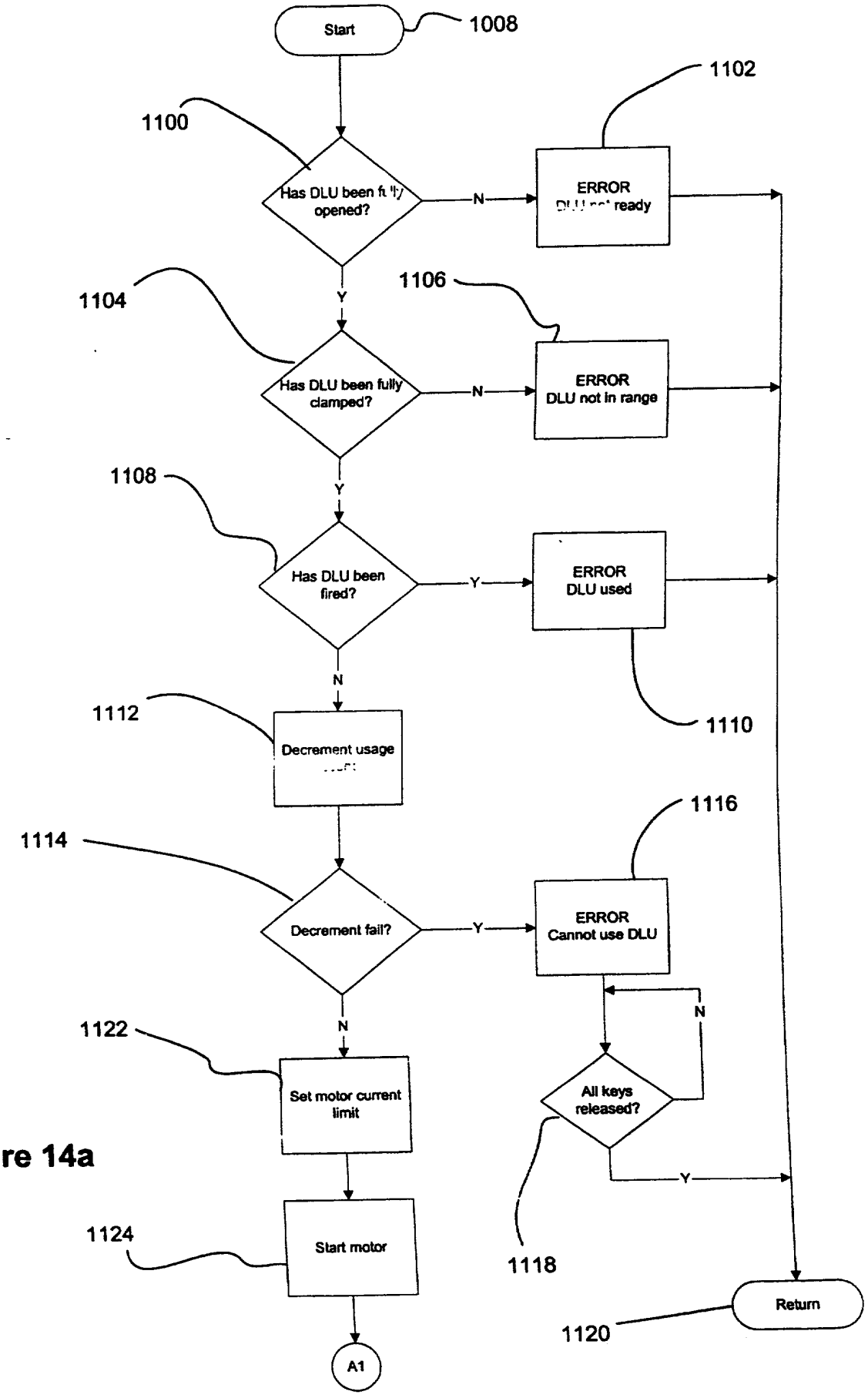

Start
1008
1100
Has DLU been fully opened?
N
1102
ERROR
DLU not ready
Y
1104
Has DLU been fully clamped?
N
1106
ERROR
DLU not in range
Y
1108
Has DLU been fired?
Y
ERROR
DLU used
1110
N
1112
Decrement usage
1114
Decrement fail?
Y
1116
ERROR
Cannot use DLU
N
1122
Set motor current limit
All keys released?
N
Y
1118
1124
Start motor
Return
1120
A1

Figure 14a

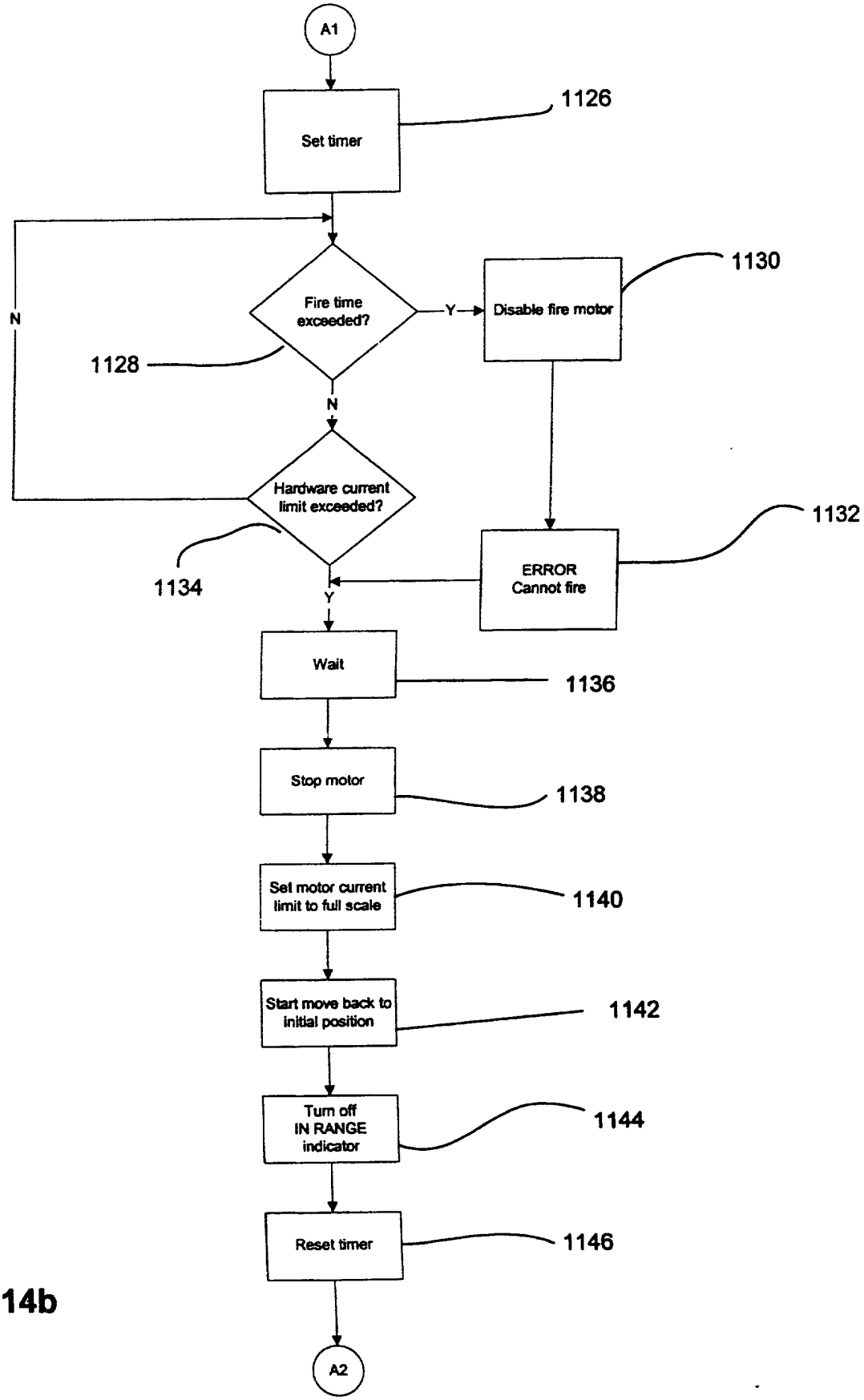

A1
Set timer
1126
Fire time exceeded?
Y
Disable fire motor
1130
N
1128
N
Hardware current limit exceeded?
1132
ERROR Cannot fire
1134
Y
Wait
1136
Stop motor
1138
Set motor current limit to full scale
1140
Start move back to initial position
1142
Turn off IN RANGE indicator
1144
Reset timer
1146
A2

Figure 14b

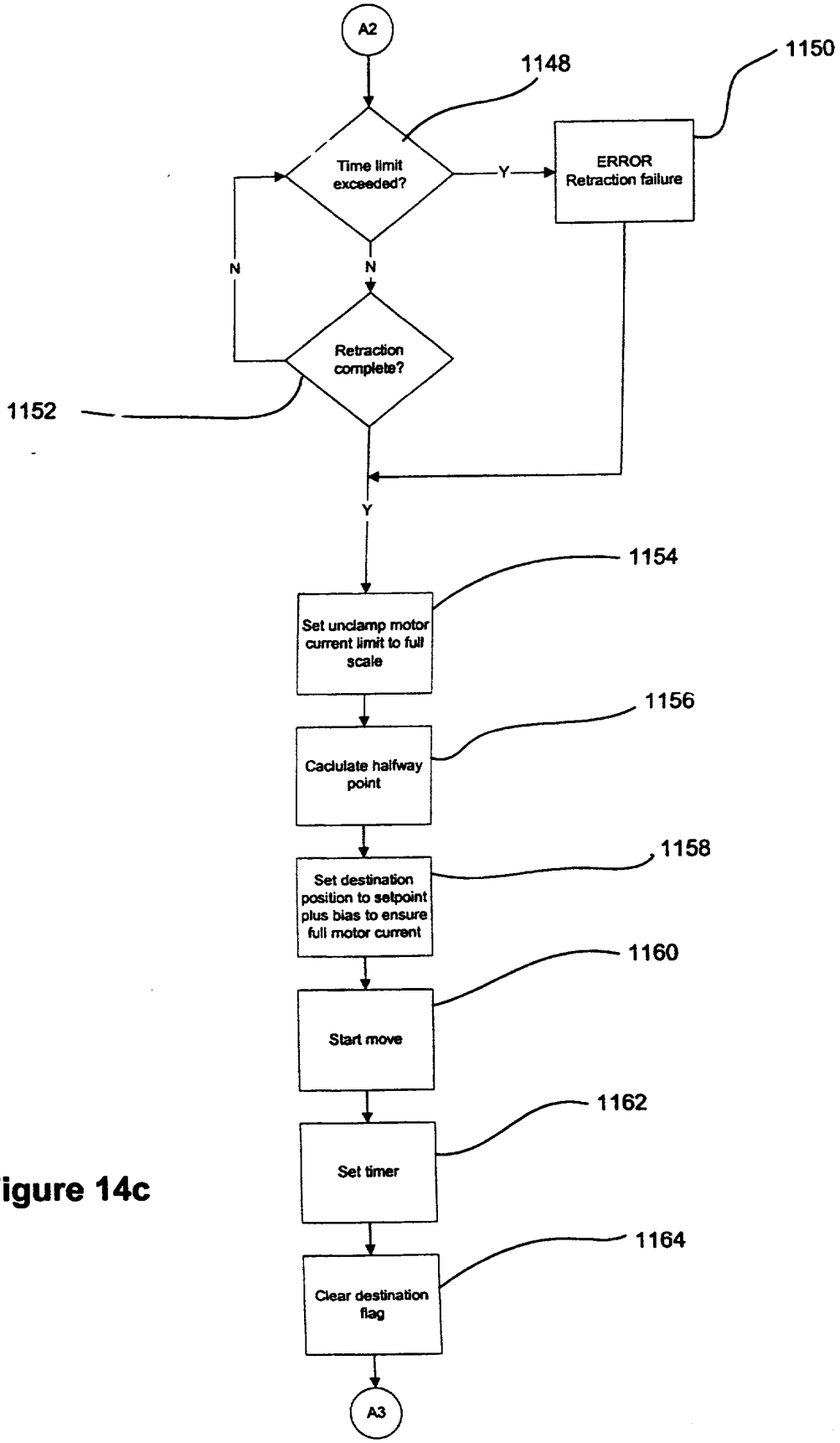

A2
1148
1150
Time limit exceeded?
Y
ERROR Retraction failure
N
N
Retraction complete?
1152
Y
1154
Set unclamp motor current limit to full scale
1156
Caculate halfway point
1158
Set destination position to setpoint plus bias to ensure full motor current
1160
Start move
1162
Set timer
1164
Clear destination flag
A3

Figure 14c

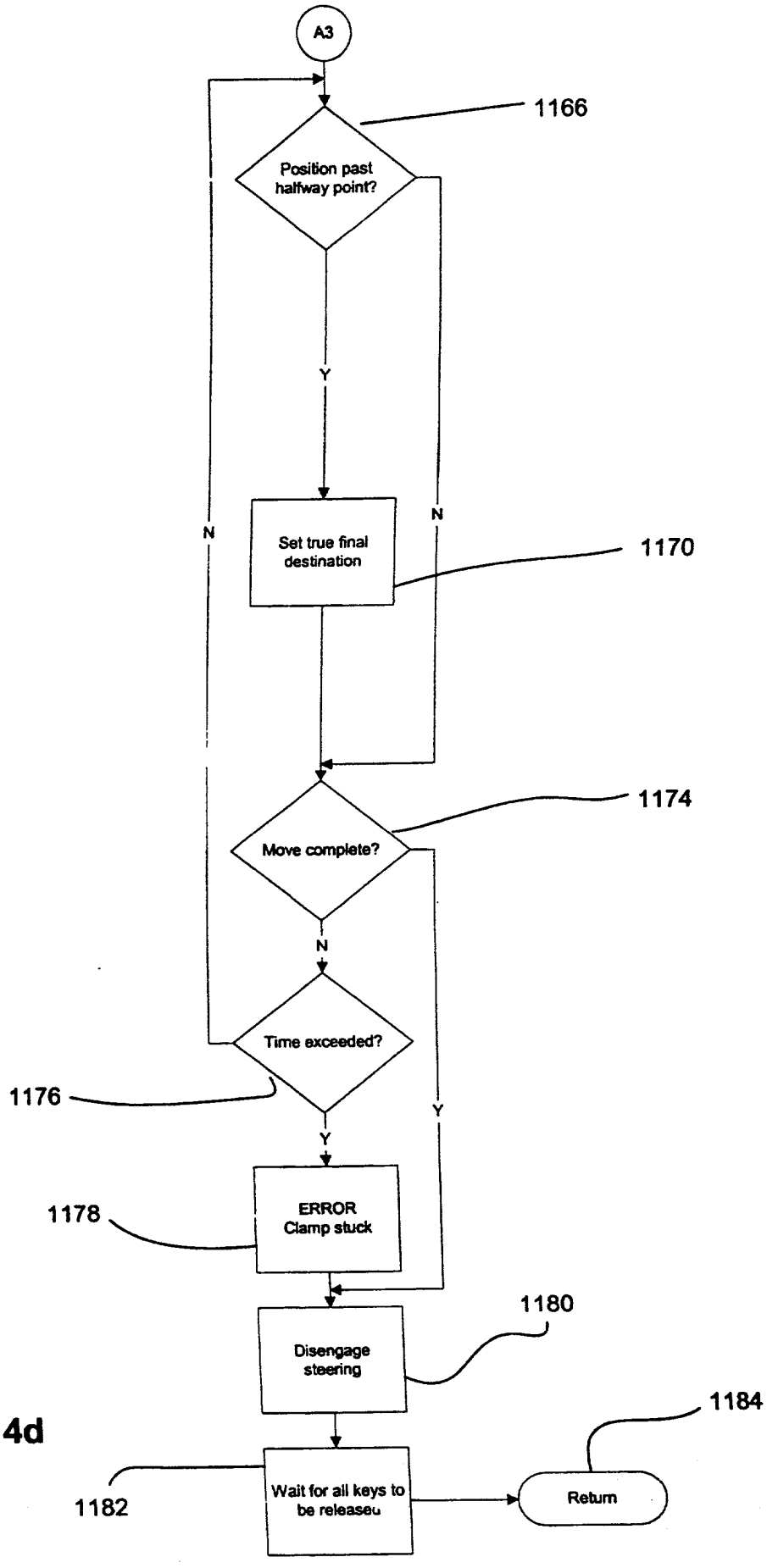

A3
1166
Position past halfway point?
Y
N
N
Set true final destination
1170
1174
Move complete?
N
Y
Time exceeded?
1176
Y
1178
ERROR Clamp stuck
1180
Disengage steering
1184
1182
Wait for all keys to be released
Return

Figure 14d

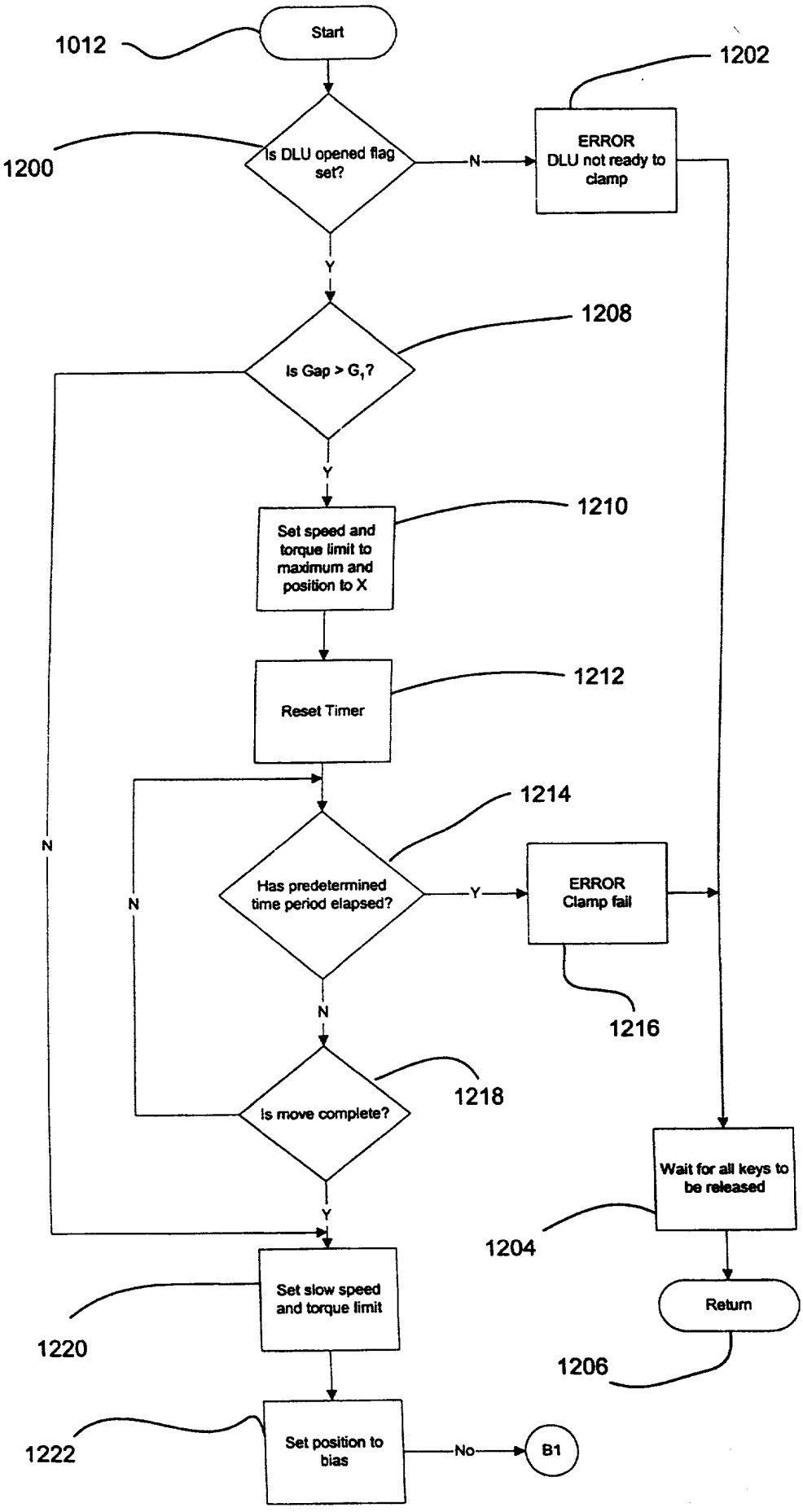

Start
1012
1200
Is DLU opened flag set?
N
1202
ERROR
DLU not ready to clamp
Y
1208
Is Gap > G_1?
Y
1210
Set speed and torque limit to maximum and position to X
1212
Reset Timer
1214
Has predetermined time period elapsed?
Y
ERROR
Clamp fail
1216
N
N
N
1218
Is move complete?
Y
Wait for all keys to be released
1204
Return
1206
Set slow speed and torque limit
1220
Set position to bias
1222
No
B1

Figure 15a

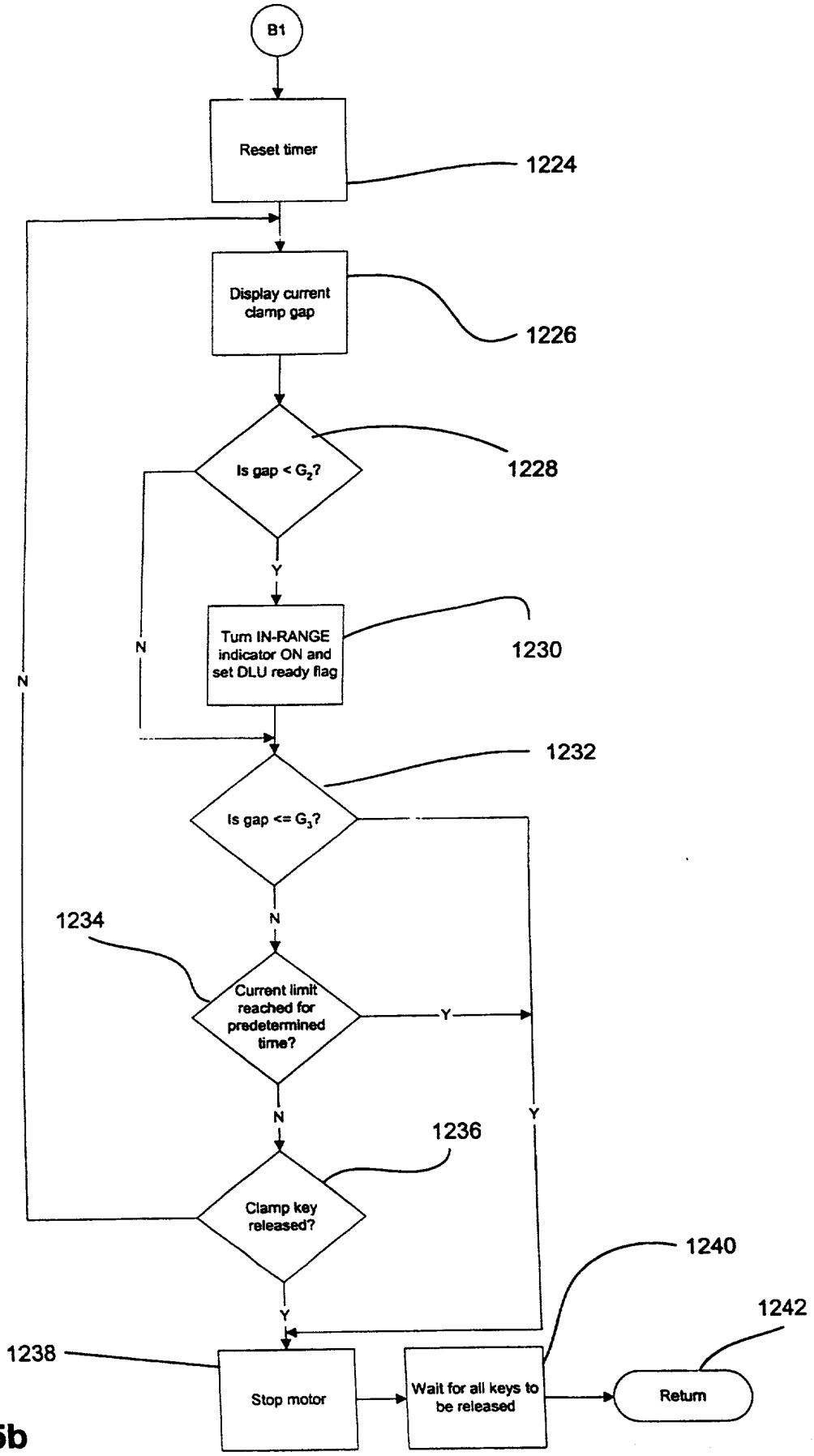

B1
Reset timer
1224
Display current clamp gap
1226
Is gap < G_2?
1228
Y
N
Turn IN-RANGE indicator ON and set DLU ready flag
1230
1232
Is gap <= G_3?
N
1234
Current limit reached for predetermined time?
Y
N
Y
1236
Clamp key released?
N
Y
1240
1242
1238
Stop motor
Wait for all keys to be released
Return

Figure 15b

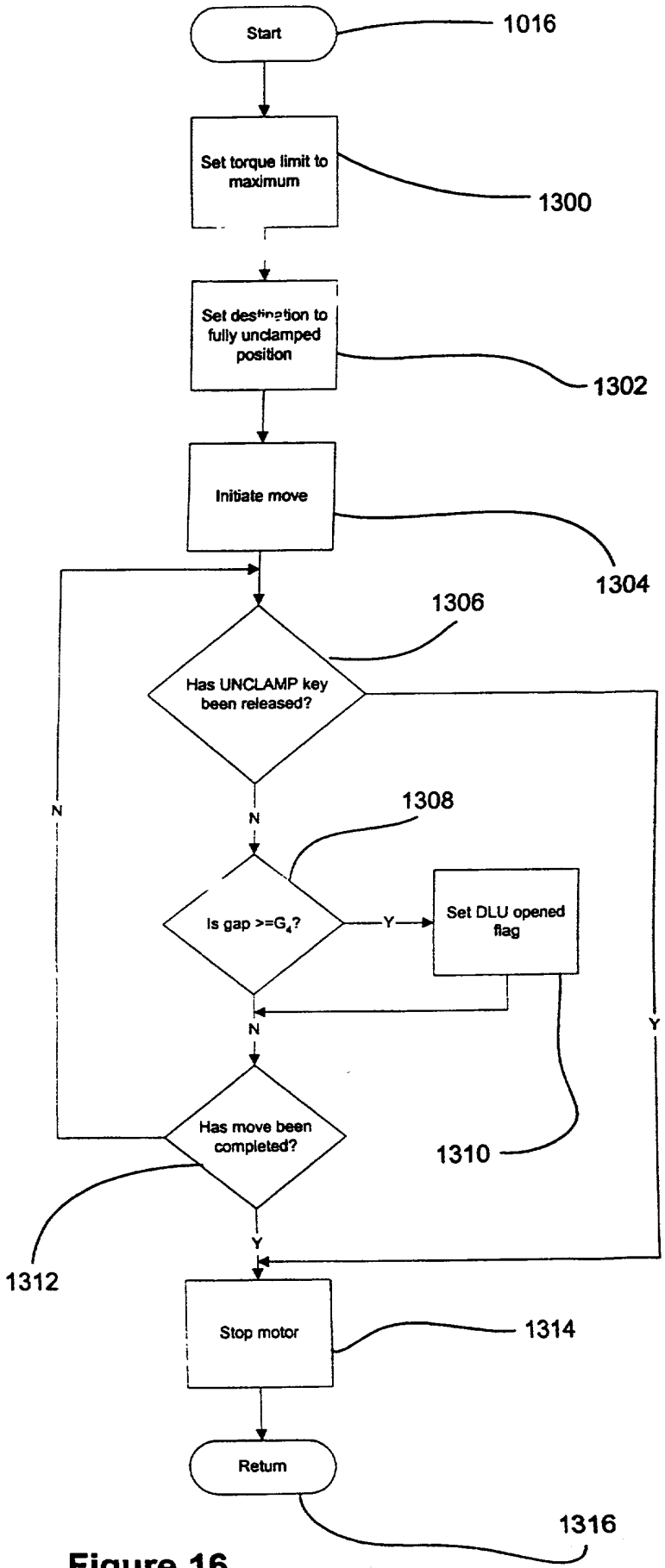

Start
1016
Set torque limit to maximum
1300
Set destination to fully unclamped position
1302
Initiate move
1304
1306
Has UNCLAMP key been released?
N
Y
1308
Is gap >=G4?
Y
Set DLU opened flag
N
Y
Has move been completed?
1310
1312
Y
Stop motor
1314
Return
1316

Figure 16

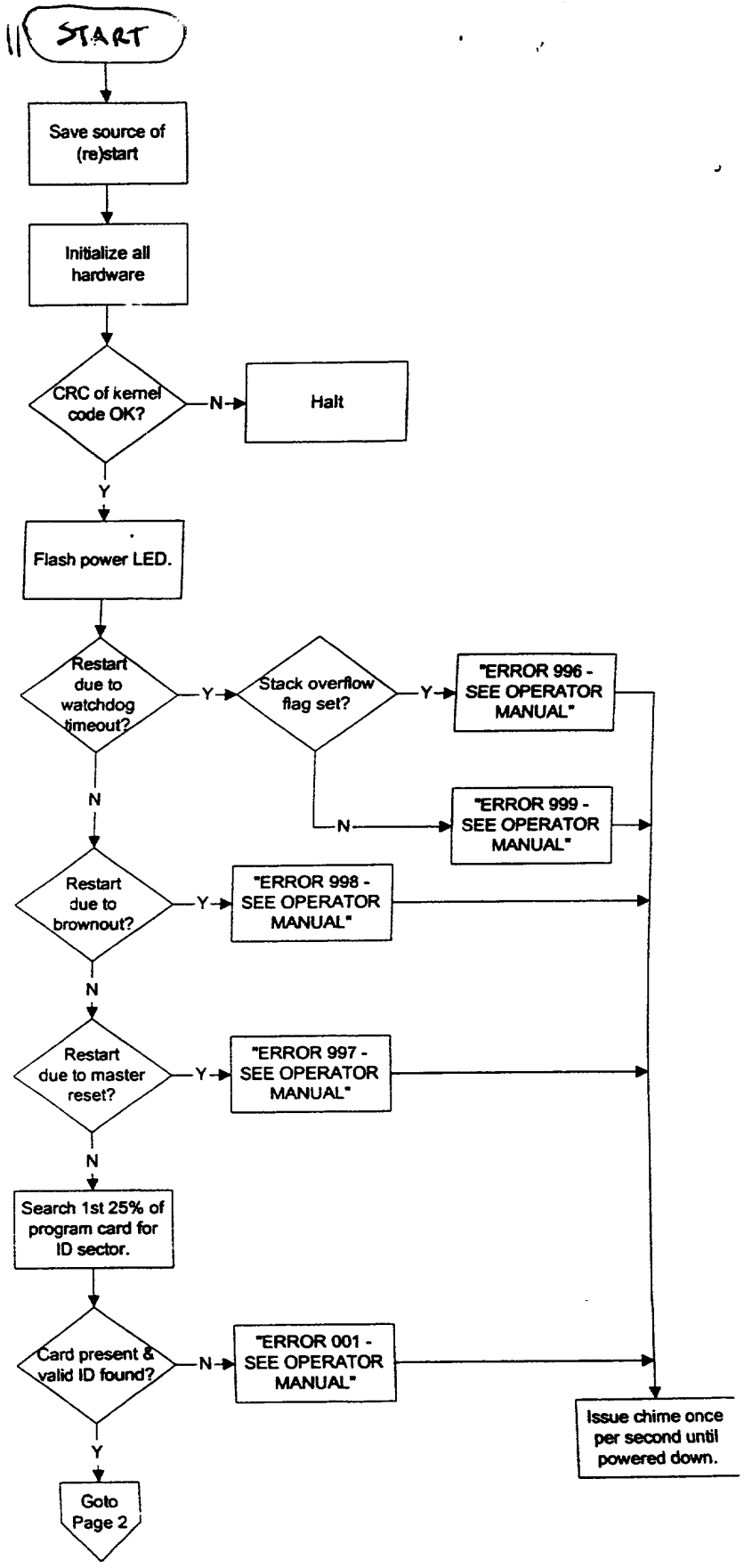

START
Save source of (re)start
Initialize all hardware
CRC of kernel code OK?
N
Halt
Y
Flash power LED.
Restart due to watchdog timeout?
Y
Stack overflow flag set?
Y
"ERROR 996 - SEE OPERATOR MANUAL"
N
"ERROR 999 - SEE OPERATOR MANUAL"
N
Restart due to brownout?
Y
"ERROR 998 - SEE OPERATOR MANUAL"
N
Restart due to master reset?
Y
"ERROR 997 - SEE OPERATOR MANUAL"
N
Search 1st 25% of program card for ID sector.
Card present & valid ID found?
N
"ERROR 001 - SEE OPERATOR MANUAL"
Y
Goto Page 2
Issue chime once per second until powered down.

FIG. 19a

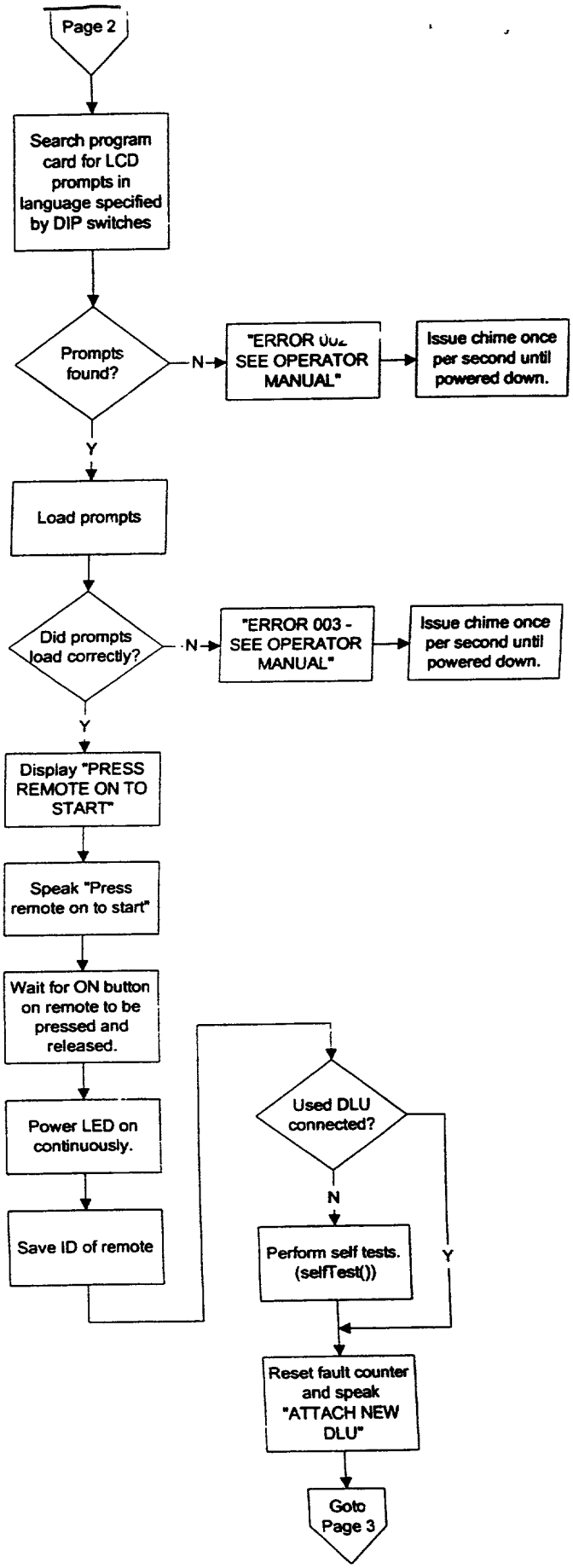

Page 2
Search program card for LCD prompts in language specified by DIP switches
Prompts found?
N
"ERROR 002 - SEE OPERATOR MANUAL"
Issue chime once per second until powered down.
Y
Load prompts
Did prompts load correctly?
N
"ERROR 003 - SEE OPERATOR MANUAL"
Issue chime once per second until powered down.
Y
Display "PRESS REMOTE ON TO START"
Speak "Press remote on to start"
Wait for ON button on remote to be pressed and released.
Power LED on continuously.
Save ID of remote
Used DLU connected?
N
Perform self tests. (selfTest())
Y
Reset fault counter and speak "ATTACH NEW DLU"
Goto Page 3

FIG. 17b

Main processing loop

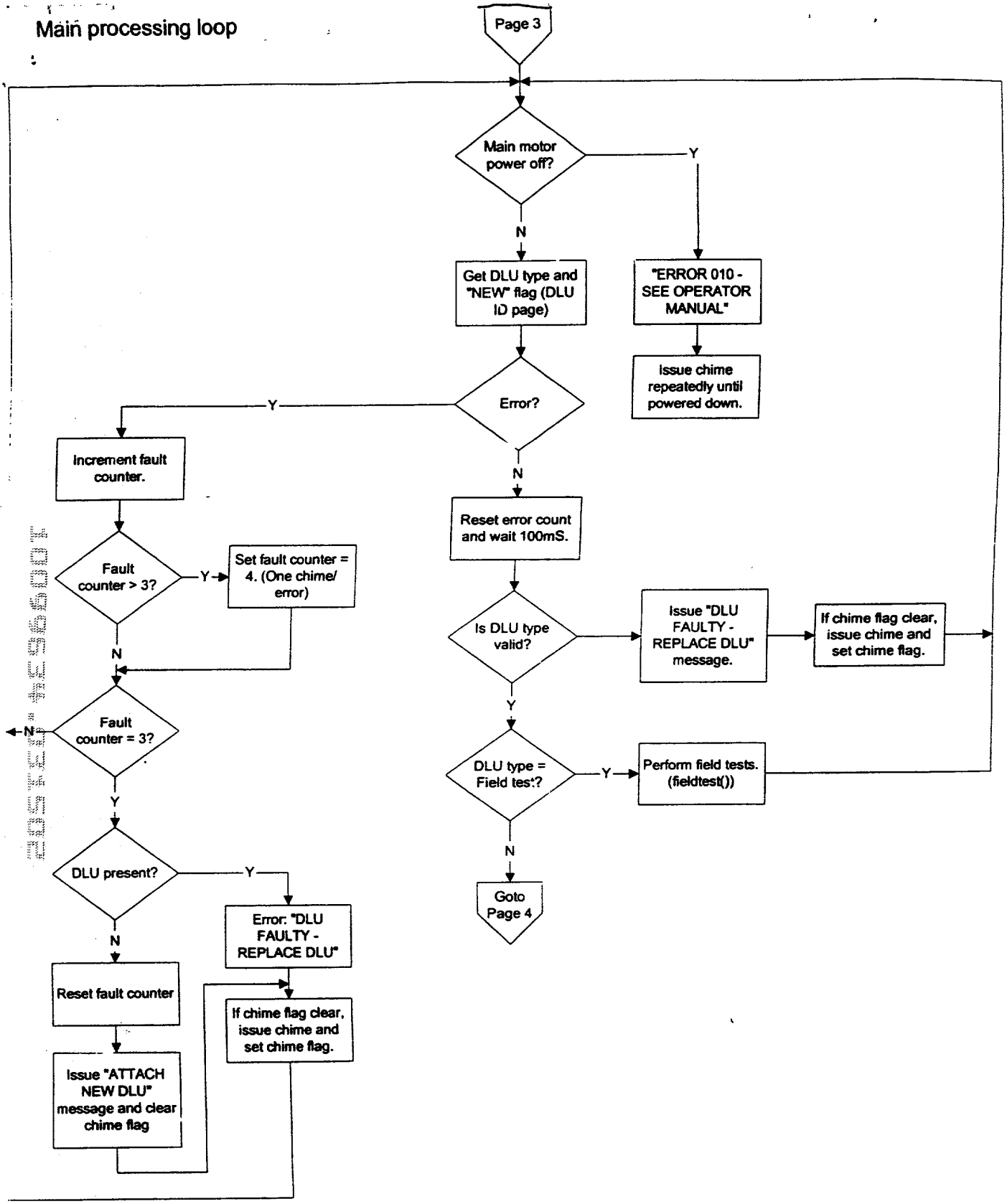


FIG. 19c

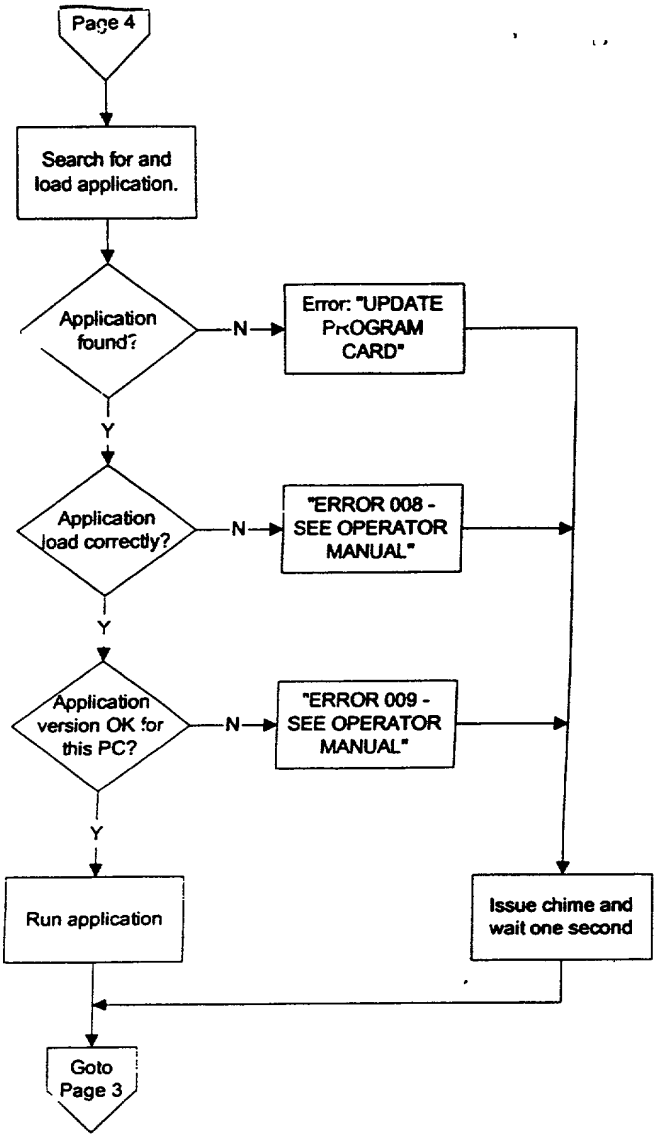

Page 4
Search for and load application.
Application found?
N
Error: "UPDATE PROGRAM CARD"
Y
Application load correctly?
N
"ERROR 008 - SEE OPERATOR MANUAL"
Y
Application version OK for this PC?
N
"ERROR 009 - SEE OPERATOR MANUAL"
Y
Run application
Issue chime and wait one second
Goto Page 3

FIG. 17d

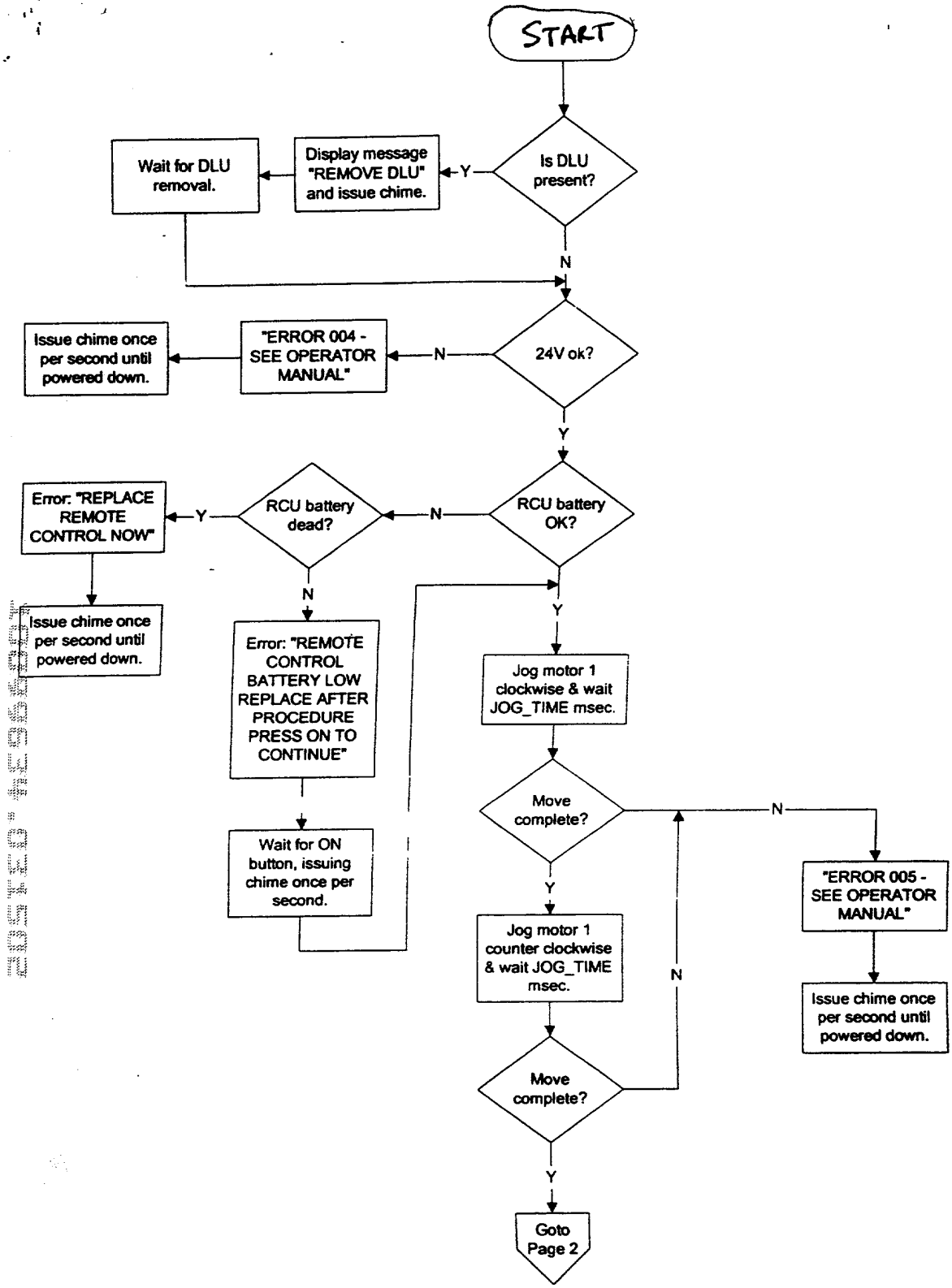

START
Is DLU present?
Y
Display message "REMOVE DLU" and issue chime.
Wait for DLU removal.
N
24V ok?
N
"ERROR 004 - SEE OPERATOR MANUAL"
Issue chime once per second until powered down.
Y
RCU battery OK?
N
RCU battery dead?
Y
Error: "REPLACE REMOTE CONTROL NOW"
Issue chime once per second until powered down.
N
Error: "REMOTE CONTROL BATTERY LOW REPLACE AFTER PROCEDURE PRESS ON TO CONTINUE"
Wait for ON button, issuing chime once per second.
Y
Jog motor 1 clockwise & wait JOG_TIME msec.
Move complete?
N
"ERROR 005 - SEE OPERATOR MANUAL"
Issue chime once per second until powered down.
Y
Jog motor 1 counter clockwise & wait JOG_TIME msec.
Move complete?
N
Y
Goto Page 2

FIG. 18a

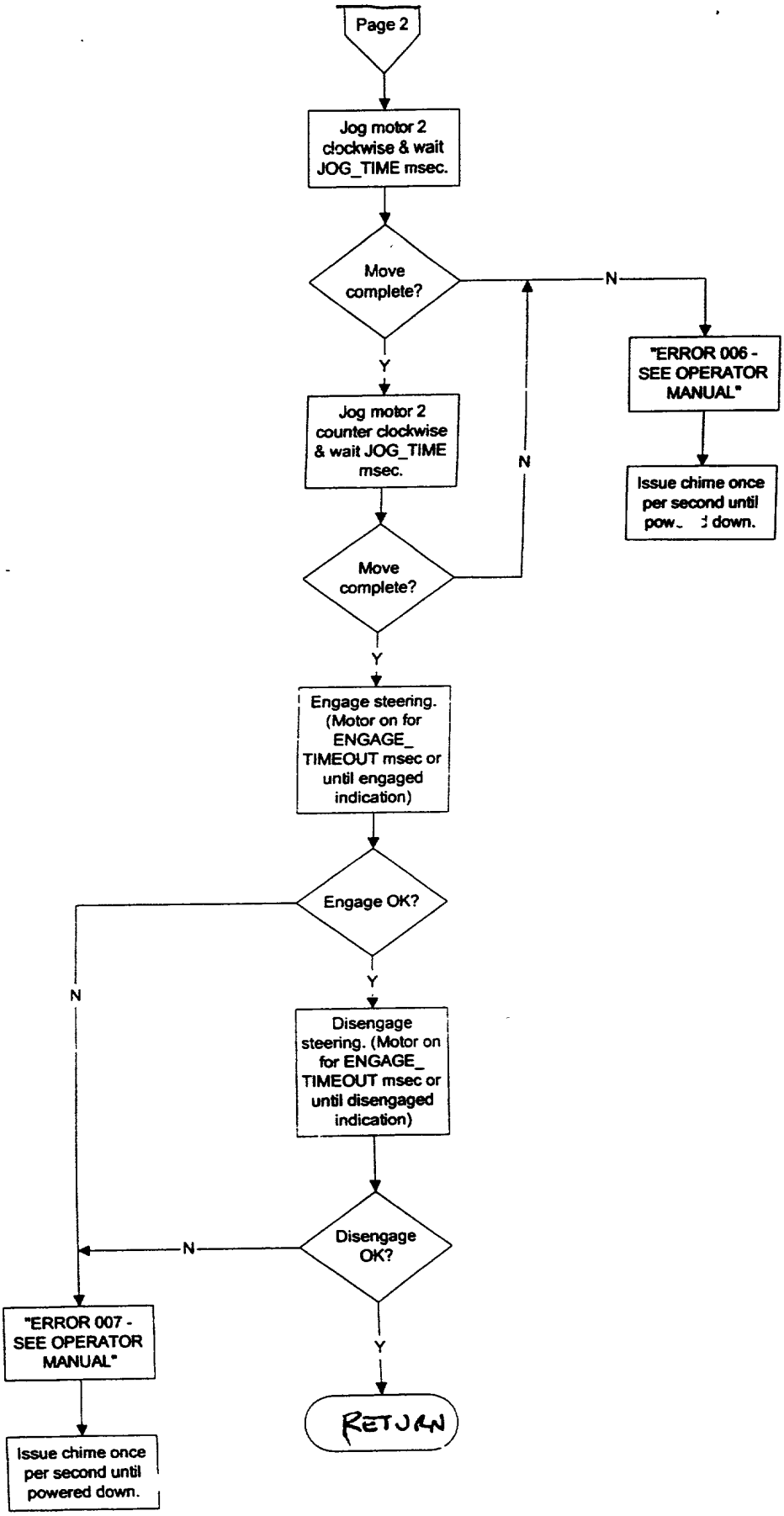

Page 2
Jog motor 2 clockwise & wait JOG_TIME msec.
Move complete?
N
Y
"ERROR 006 - SEE OPERATOR MANUAL"
Issue chime once per second until pow_ d down.
Jog motor 2 counter clockwise & wait JOG_TIME msec.
N
Move complete?
Y
Engage steering. (Motor on for ENGAGE_ TIMEOUT msec or until engaged indication)
Engage OK?
N
Y
Disengage steering. (Motor on for ENGAGE_ TIMEOUT msec or until disengaged indication)
Disengage OK?
N
Y
"ERROR 007 - SEE OPERATOR MANUAL"
Issue chime once per second until powered down.
RETURN

FIG. 18b

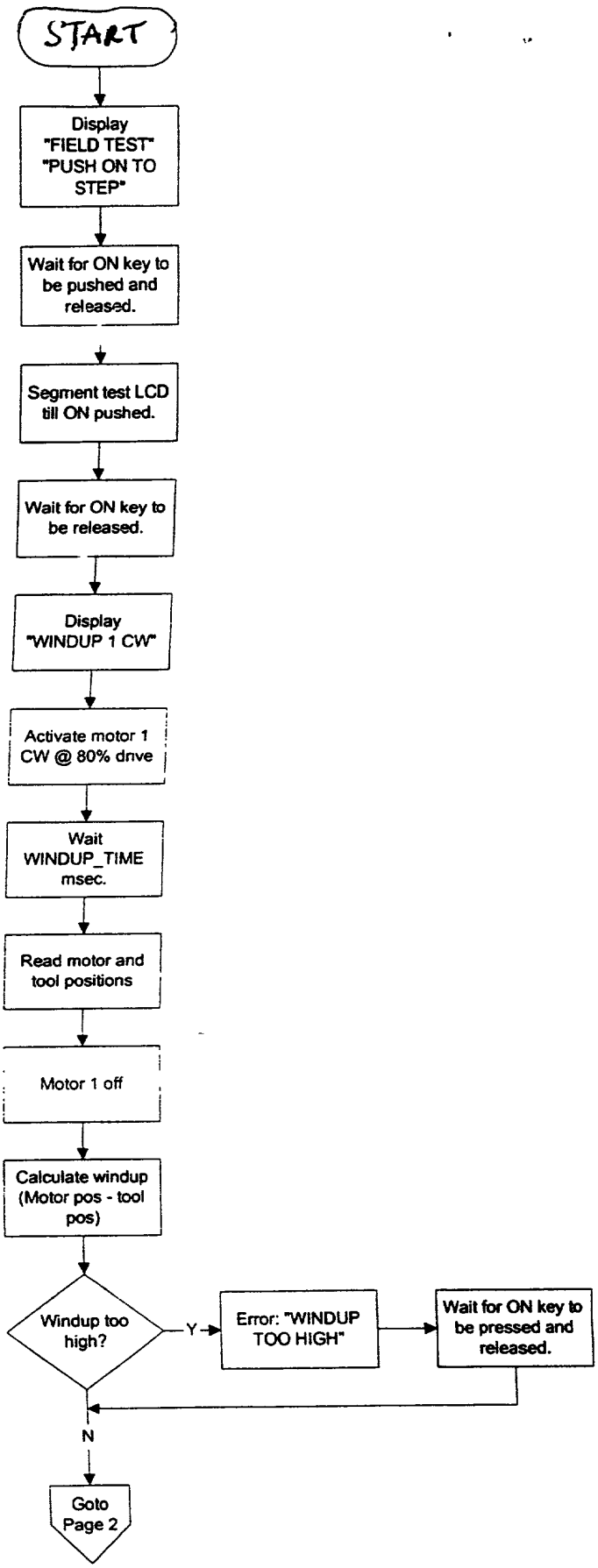

START
Display "FIELD TEST" "PUSH ON TO STEP"
Wait for ON key to be pushed and released.
Segment test LCD till ON pushed.
Wait for ON key to be released.
Display "WINDUP 1 CW"
Activate motor 1 CW @ 80% drive
Wait WINDUP_TIME msec.
Read motor and tool positions
Motor 1 off
Calculate windup (Motor pos - tool pos)
Windup too high?
Y
Error: "WINDUP TOO HIGH"
Wait for ON key to be pressed and released.
N
Goto Page 2

FIG. 19a

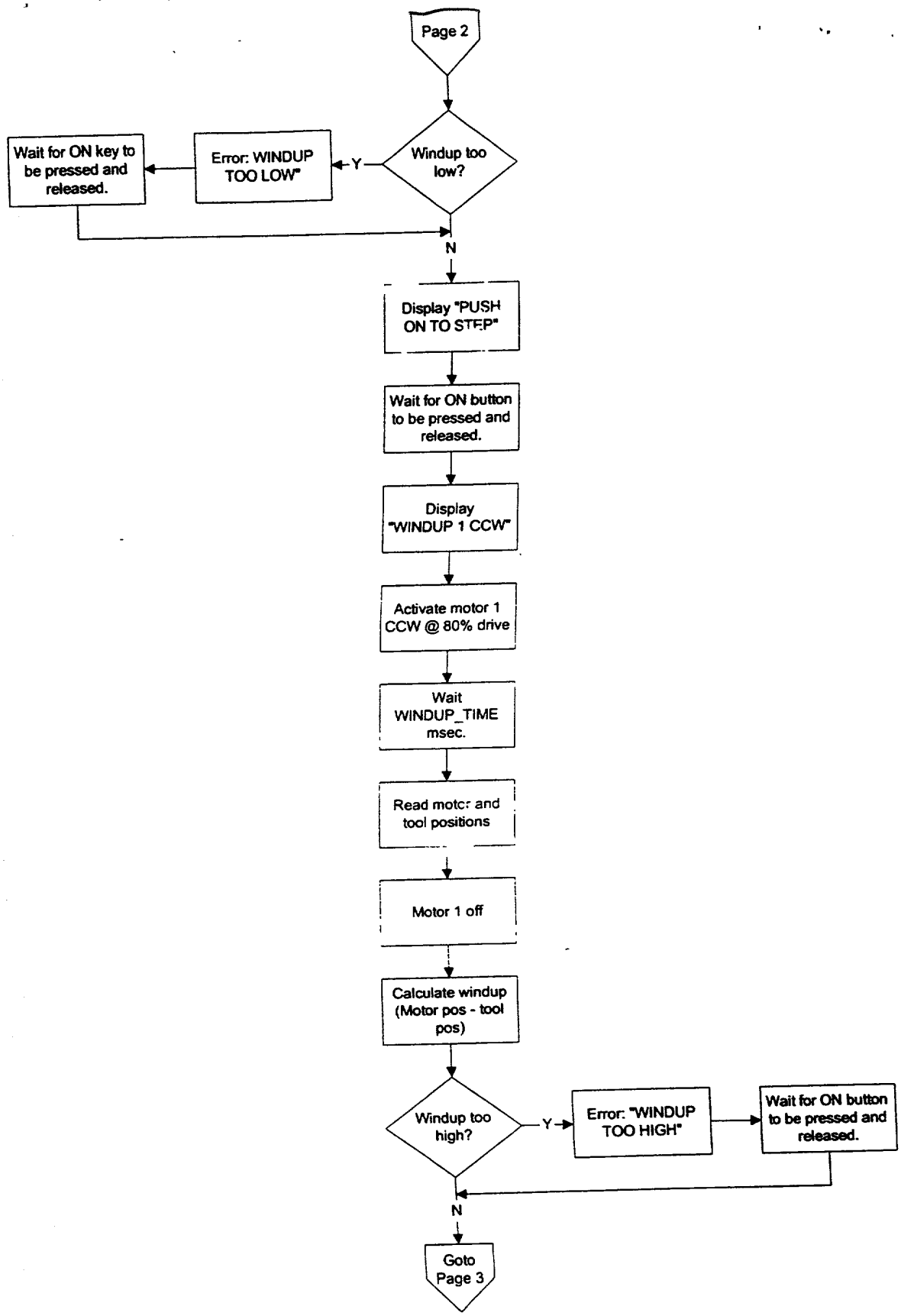

Page 2
Windup too low?
Y
Error: WINDUP TOO LOW"
Wait for ON key to be pressed and released.
N
Display "PUSH ON TO STEP"
Wait for ON button to be pressed and released.
Display "WINDUP 1 CCW"
Activate motor 1 CCW @ 80% drive
Wait WINDUP_TIME msec.
Read motor and tool positions
Motor 1 off
Calculate windup (Motor pos - tool pos)
Windup too high?
Y
Error: "WINDUP TOO HIGH"
Wait for ON button to be pressed and released.
N
Goto Page 3

FIG. 19b

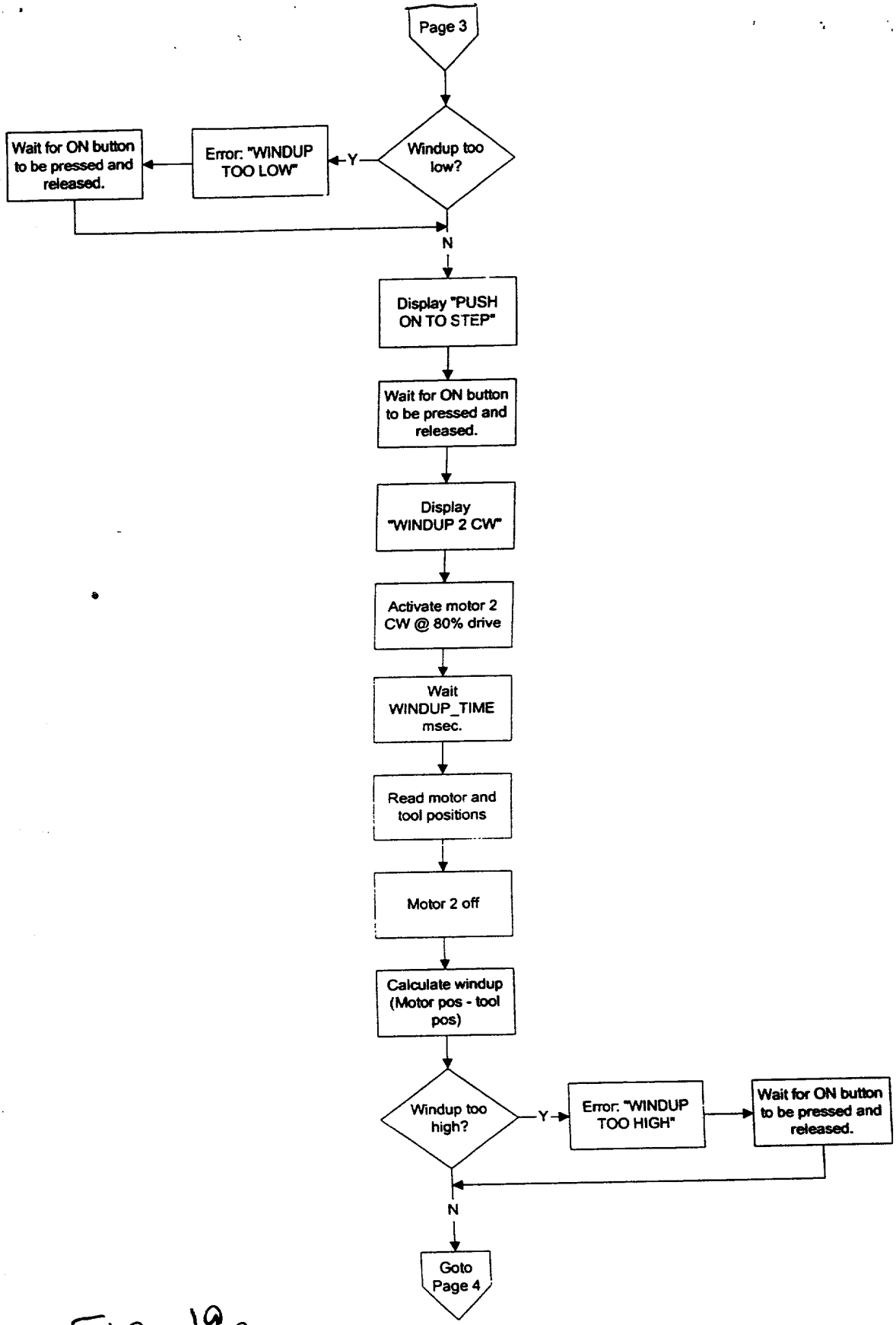

Page 3
Windup too low?
Y
Error: "WINDUP TOO LOW"
Wait for ON button to be pressed and released.
N
Display "PUSH ON TO STEP"
Wait for ON button to be pressed and released.
Display "WINDUP 2 CW"
Activate motor 2 CW @ 80% drive
Wait WINDUP_TIME msec.
Read motor and tool positions
Motor 2 off
Calculate windup (Motor pos - tool pos)
Windup too high?
Y
Error: "WINDUP TOO HIGH"
Wait for ON button to be pressed and released.
N
Goto Page 4

FIG. 19c

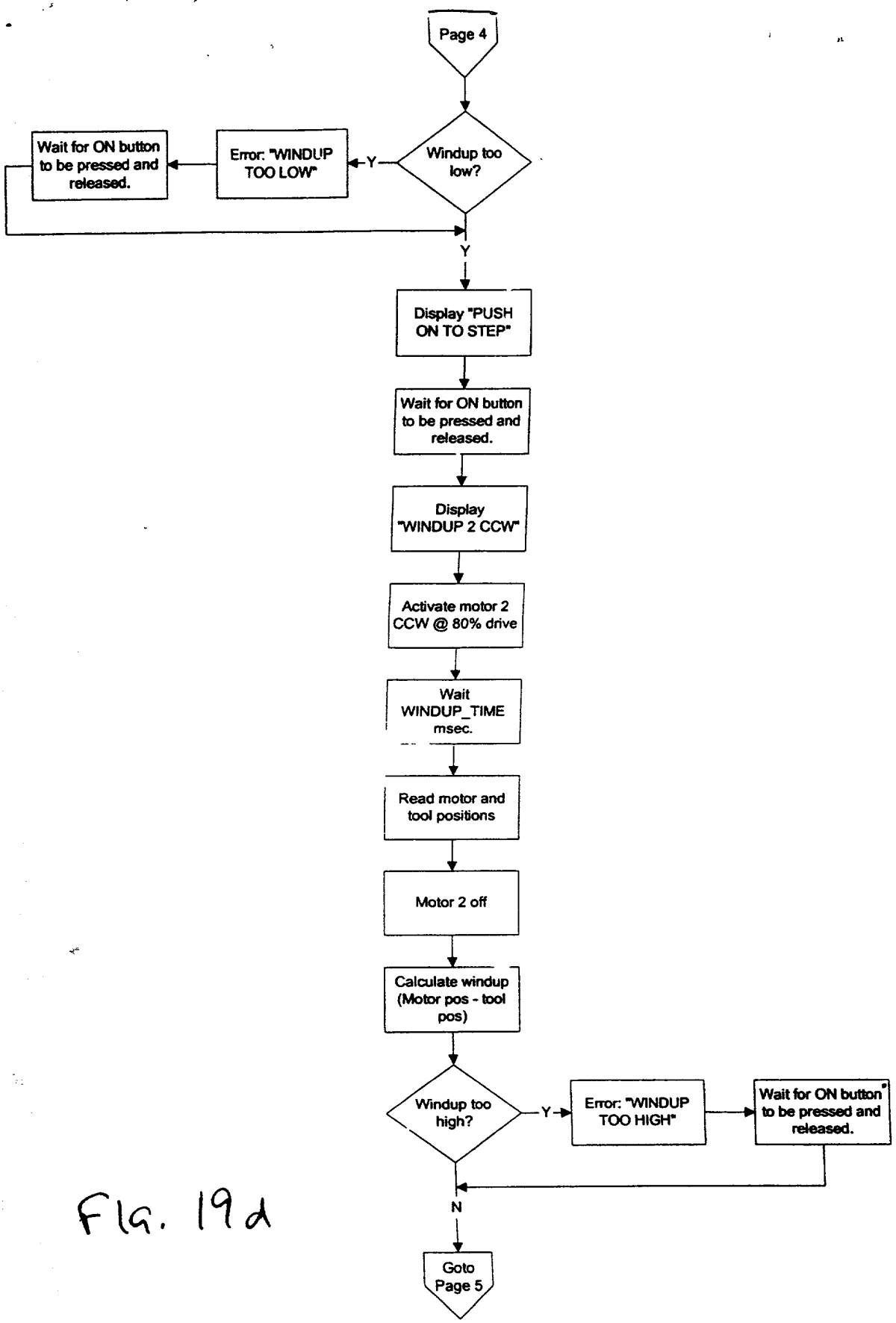

Page 4
Windup too low?
Y
Error: "WINDUP TOO LOW"
Wait for ON button to be pressed and released.
Y
Display "PUSH ON TO STEP"
Wait for ON button to be pressed and released.
Display "WINDUP 2 CCW"
Activate motor 2 CCW @ 80% drive
Wait WINDUP_TIME msec.
Read motor and tool positions
Motor 2 off
Calculate windup (Motor pos - tool pos)
Windup too high?
Y
Error: "WINDUP TOO HIGH"
Wait for ON button to be pressed and released.
N
Goto Page 5

Fig. 19d

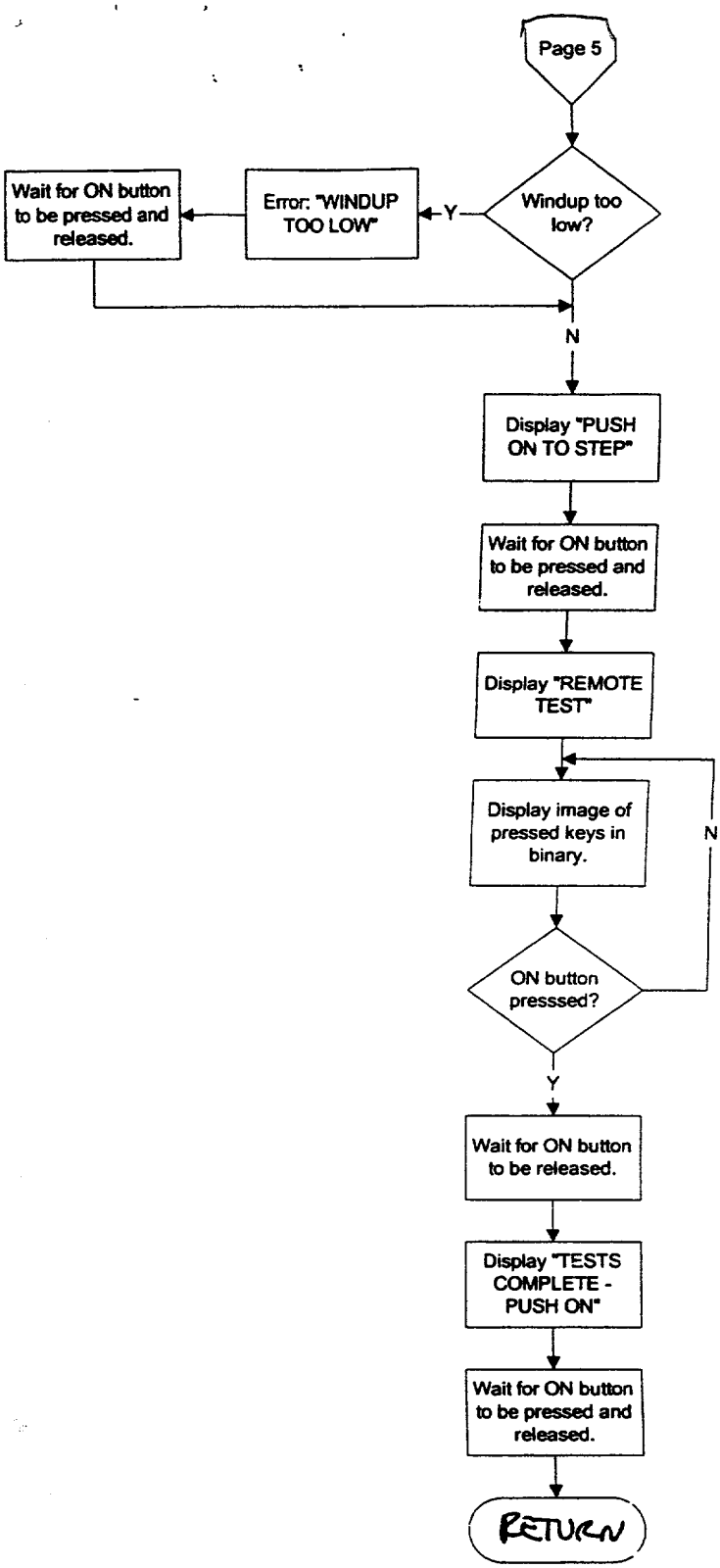

Page 5
Windup too low?
Y
Error: "WINDUP TOO LOW"
Wait for ON button to be pressed and released.
N
Display "PUSH ON TO STEP"
Wait for ON button to be pressed and released.
Display "REMOTE TEST"
Display image of pressed keys in binary.
ON button presssed?
N
Y
Wait for ON button to be released.
Display "TESTS COMPLETE - PUSH ON"
Wait for ON button to be pressed and released.
RETURN

FIG. 19e

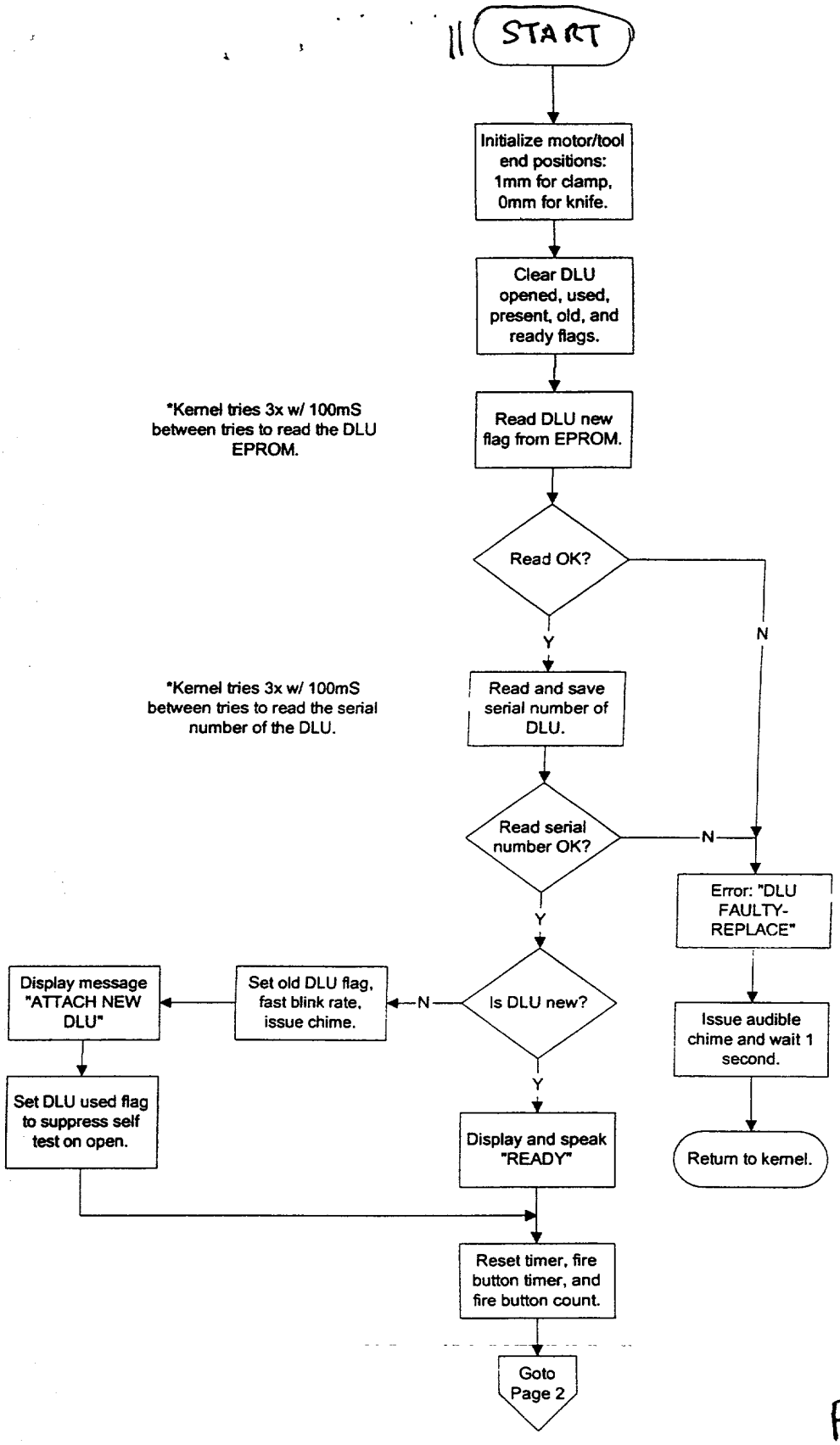

START
Initialize motor/tool end positions: 1mm for clamp, 0mm for knife.
Clear DLU opened, used, present, old, and ready flags.
*Kernel tries 3x w/ 100mS between tries to read the DLU EPROM.
Read DLU new flag from EPROM.
Read OK?
Y
N
*Kernel tries 3x w/ 100mS between tries to read the serial number of the DLU.
Read and save serial number of DLU.
Read serial number OK?
N
Y
Error: "DLU FAULTY- REPLACE"
Display message "ATTACH NEW DLU"
Set old DLU flag, fast blink rate, issue chime.
N
Is DLU new?
Issue audible chime and wait 1 second.
Y
Set DLU used flag to suppress self test on open.
Display and speak "READY"
Return to kernel.
Reset timer, fire button timer, and fire button count.
Goto Page 2

FIG. 20a

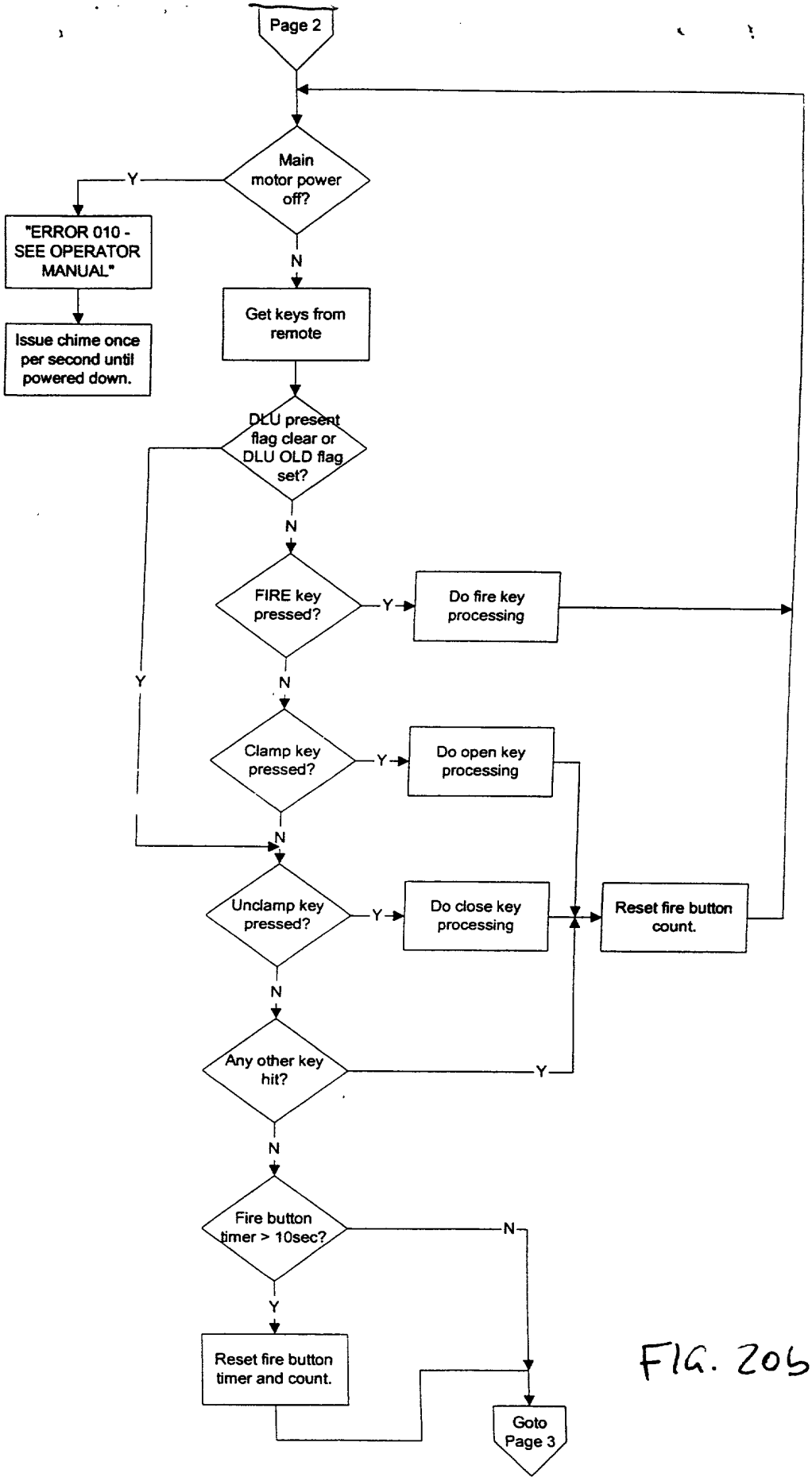

Page 2
Main motor power off?
Y
"ERROR 010 - SEE OPERATOR MANUAL"
Issue chime once per second until powered down.
N
Get keys from remote
DLU present flag clear or DLU OLD flag set?
N
FIRE key pressed?
Y
Do fire key processing
Y
N
Clamp key pressed?
Y
Do open key processing
N
Unclamp key pressed?
Y
Do close key processing
Reset fire button count.
N
Any other key hit?
Y
N
Fire button timer > 10sec?
N
Y
Reset fire button timer and count.
Goto Page 3

FIG. 20b

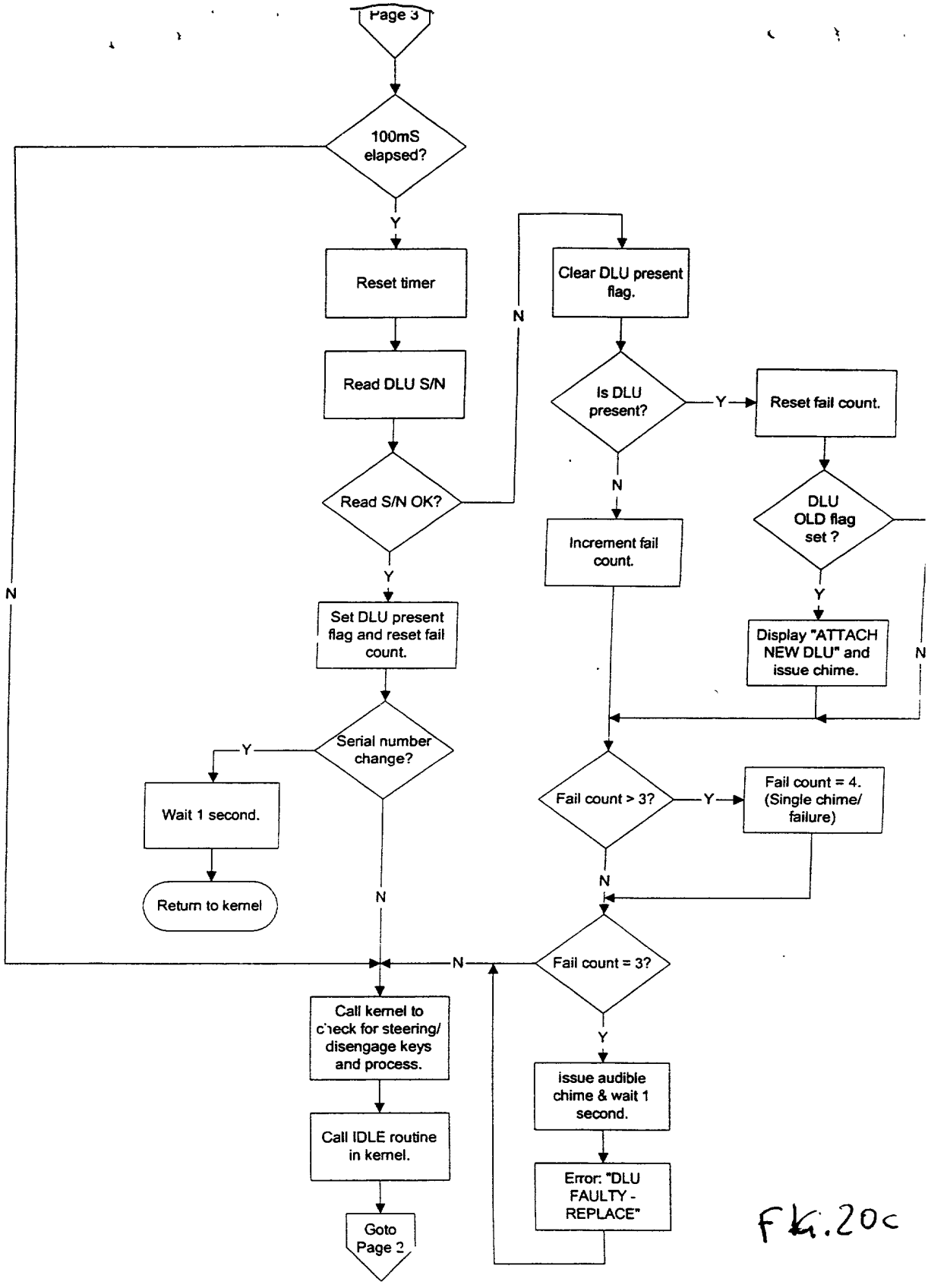

Page 3
100mS elapsed?
Y
N
Reset timer
Read DLU S/N
Read S/N OK?
Y
N
Set DLU present flag and reset fail count.
Serial number change?
Y
N
Wait 1 second.
Return to kernel
Call kernel to check for steering/ disengage keys and process.
Call IDLE routine in kernel.
Goto Page 2
Clear DLU present flag.
Is DLU present?
Y
N
Reset fail count.
DLU OLD flag set ?
Y
N
Display "ATTACH NEW DLU" and issue chime.
Increment fail count.
Fail count > 3?
Y
N
Fail count = 4. (Single chime/ failure)
Fail count = 3?
Y
N
issue audible chime & wait 1 second.
Error: "DLU FAULTY - REPLACE"

Fig. 20c

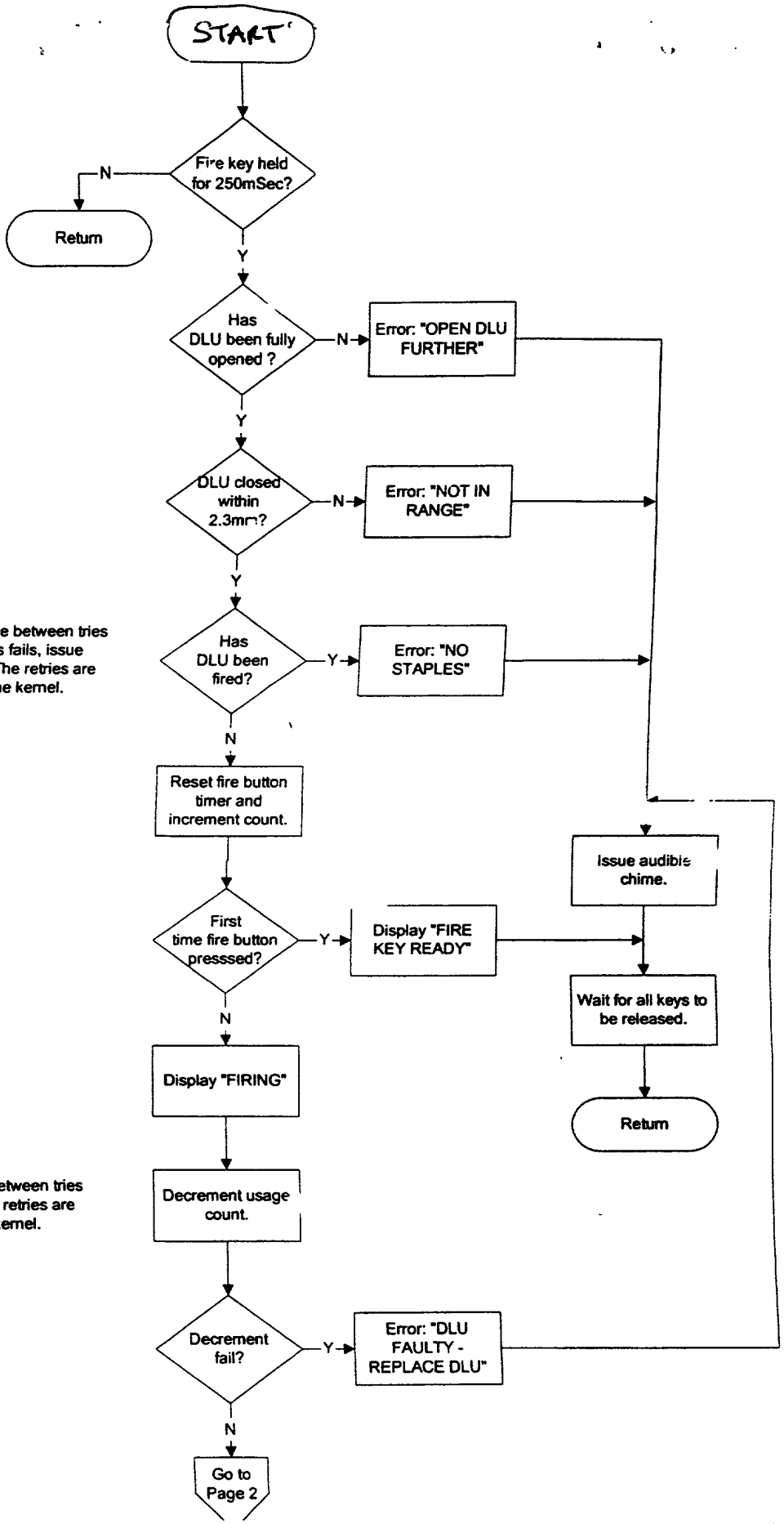
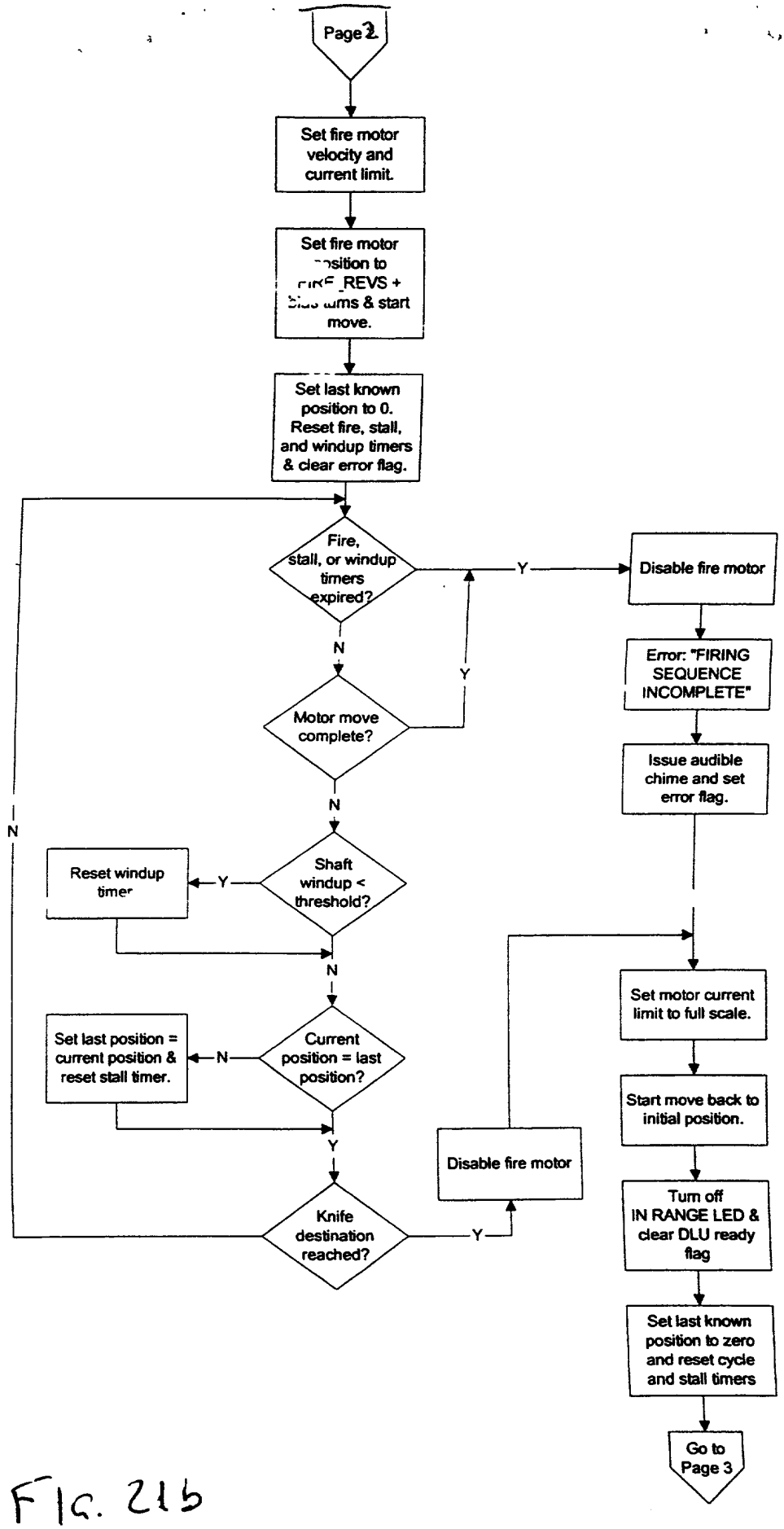

START
Fire key held for 250mSec?
N
Return
Y
Has DLU been fully opened ?
N
Error: "OPEN DLU FURTHER"
Y
DLU closed within 2.3mm?
N
Error: "NOT IN RANGE"
Y
Has DLU been fired?
Y
Error: "NO STAPLES"
N
Reset fire button timer and increment count.
First time fire button presssed?
Y
Display "FIRE KEY READY"
N
Display "FIRING"
Decrement usage count.
Decrement fail?
Y
Error: "DLU FAULTY - REPLACE DLU"
N
Go to Page 2
Issue audible chime.
Wait for all keys to be released.
Return
*Try 3x w/ 100mS time between tries to read DLU. If this fails, issue message and exit. The retries are performed by the kernel.
*Try 3x w/ 100mS time between tries to decrement DLU. The retries are performed by the kernel.

FIG. 21a



Windup threshold is defined as SHAFT_WINDUP_MAX

FIG. 21b

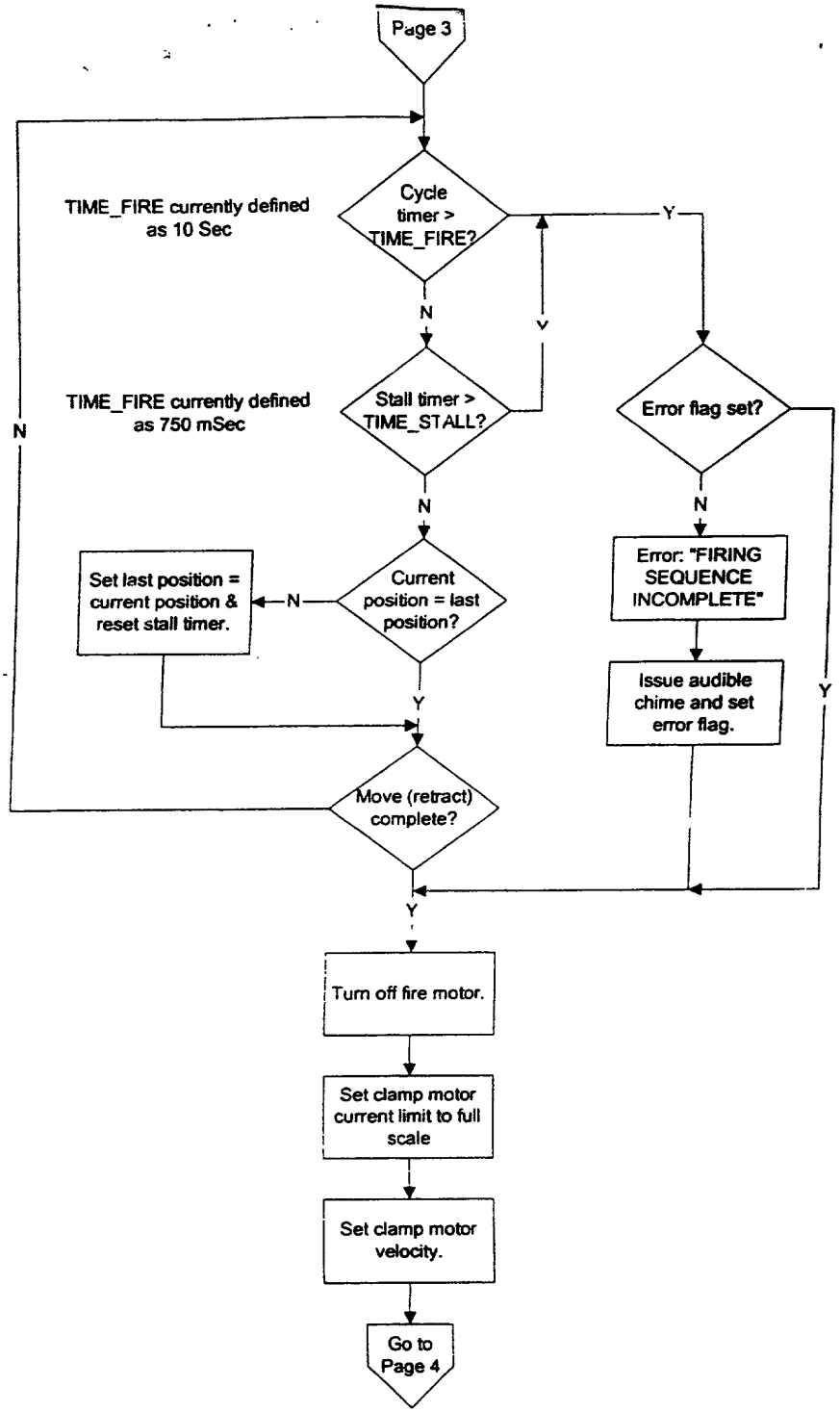

Page 3
TIME_FIRE currently defined as 10 Sec
Cycle timer > TIME_FIRE?
Y
N
TIME_FIRE currently defined as 750 mSec
Stall timer > TIME_STALL?
Error flag set?
N
N
Y
Set last position = current position & reset stall timer.
N
Current position = last position?
Error: "FIRING SEQUENCE INCOMPLETE"
Issue audible chime and set error flag.
Y
Y
Move (retract) complete?
Y
Turn off fire motor.
Set clamp motor current limit to full scale
Set clamp motor velocity.
Go to Page 4

FIG. 21c

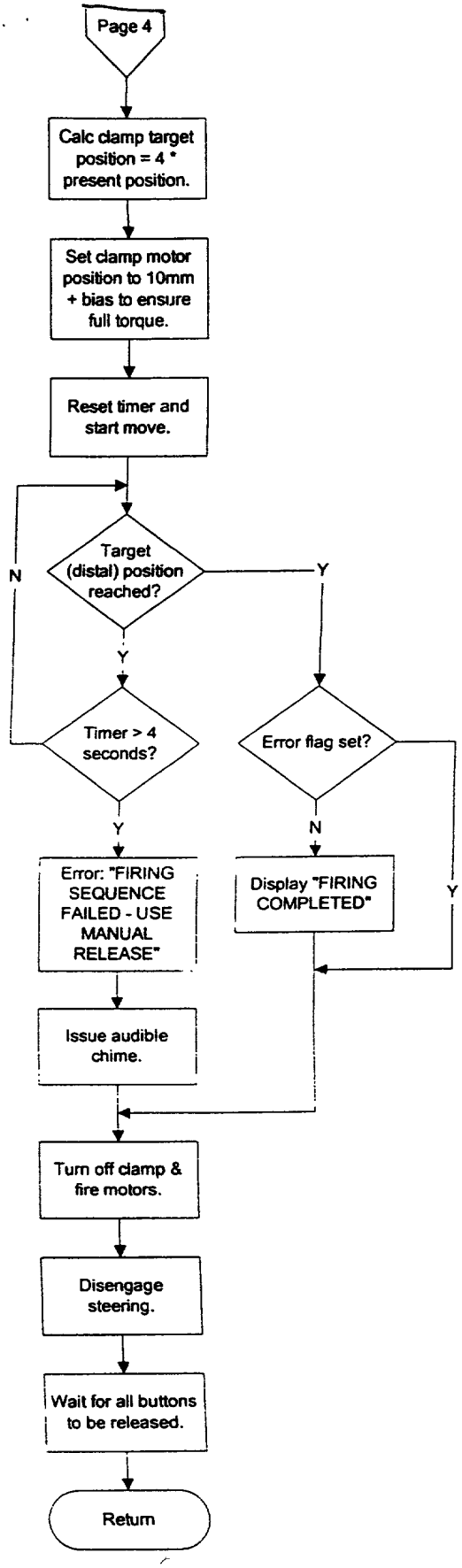

Page 4
Calc clamp target position = 4 * present position.
Set clamp motor position to 10mm + bias to ensure full torque.
Reset timer and start move.
Target (distal) position reached?
N
Y
Y
Timer > 4 seconds?
Error flag set?
Y
N
Error: "FIRING SEQUENCE FAILED - USE MANUAL RELEASE"
Display "FIRING COMPLETED"
Y
Issue audible chime.
Turn off clamp & fire motors.
Disengage steering.
Wait for all buttons to be released.
Return

FIG. 21d

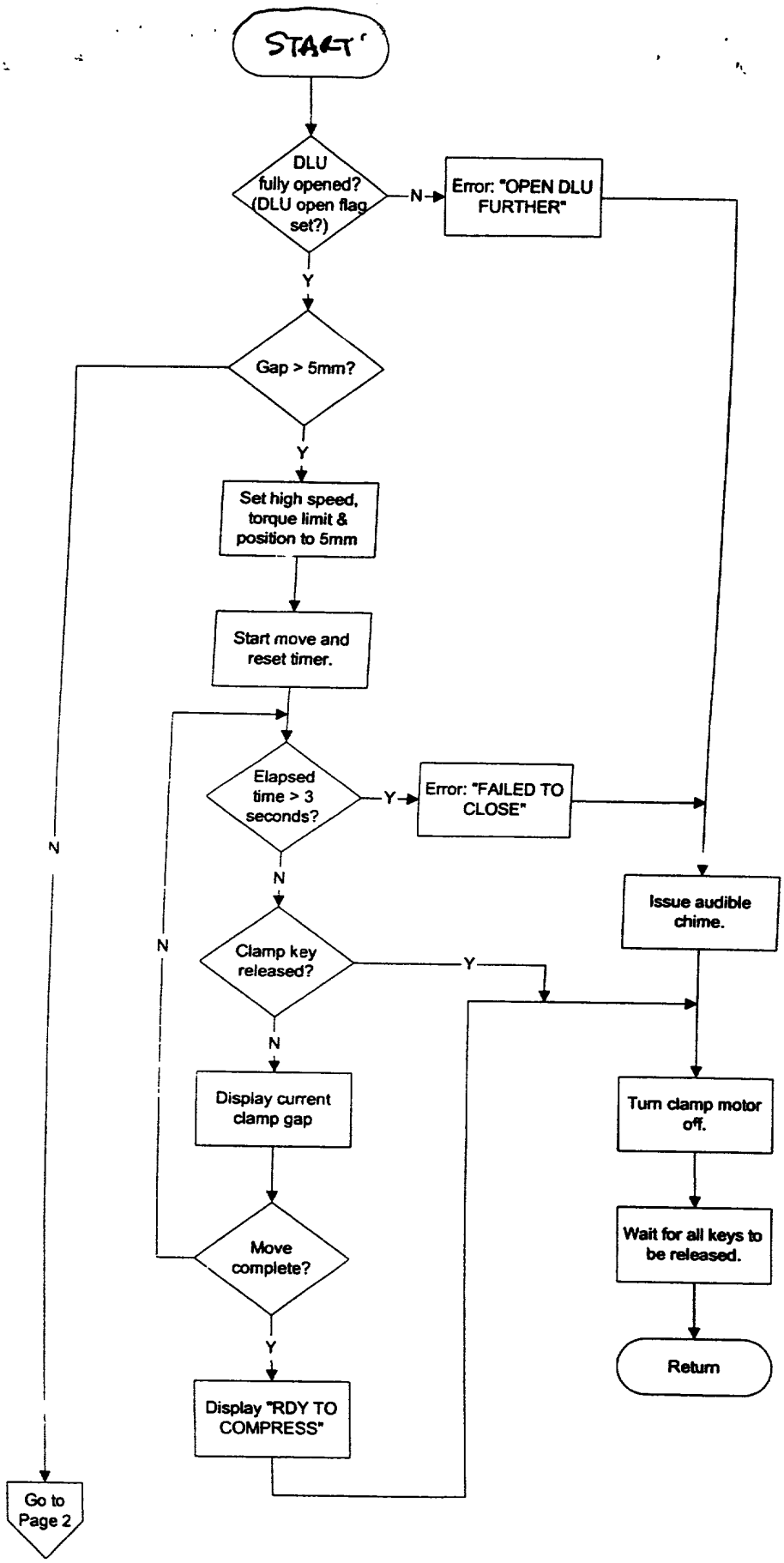

START
DLU fully opened? (DLU open flag set?)
N
Error: "OPEN DLU FURTHER"
Y
Gap > 5mm?
N
Y
Set high speed, torque limit & position to 5mm
Start move and reset timer.
Elapsed time > 3 seconds?
Y
Error: "FAILED TO CLOSE"
N
Clamp key released?
Y
N
Display current clamp gap
Move complete?
N
Y
Display "RDY TO COMPRESS"
Issue audible chime.
Turn clamp motor off.
Wait for all keys to be released.
Return
Go to Page 2

FIG. 22a

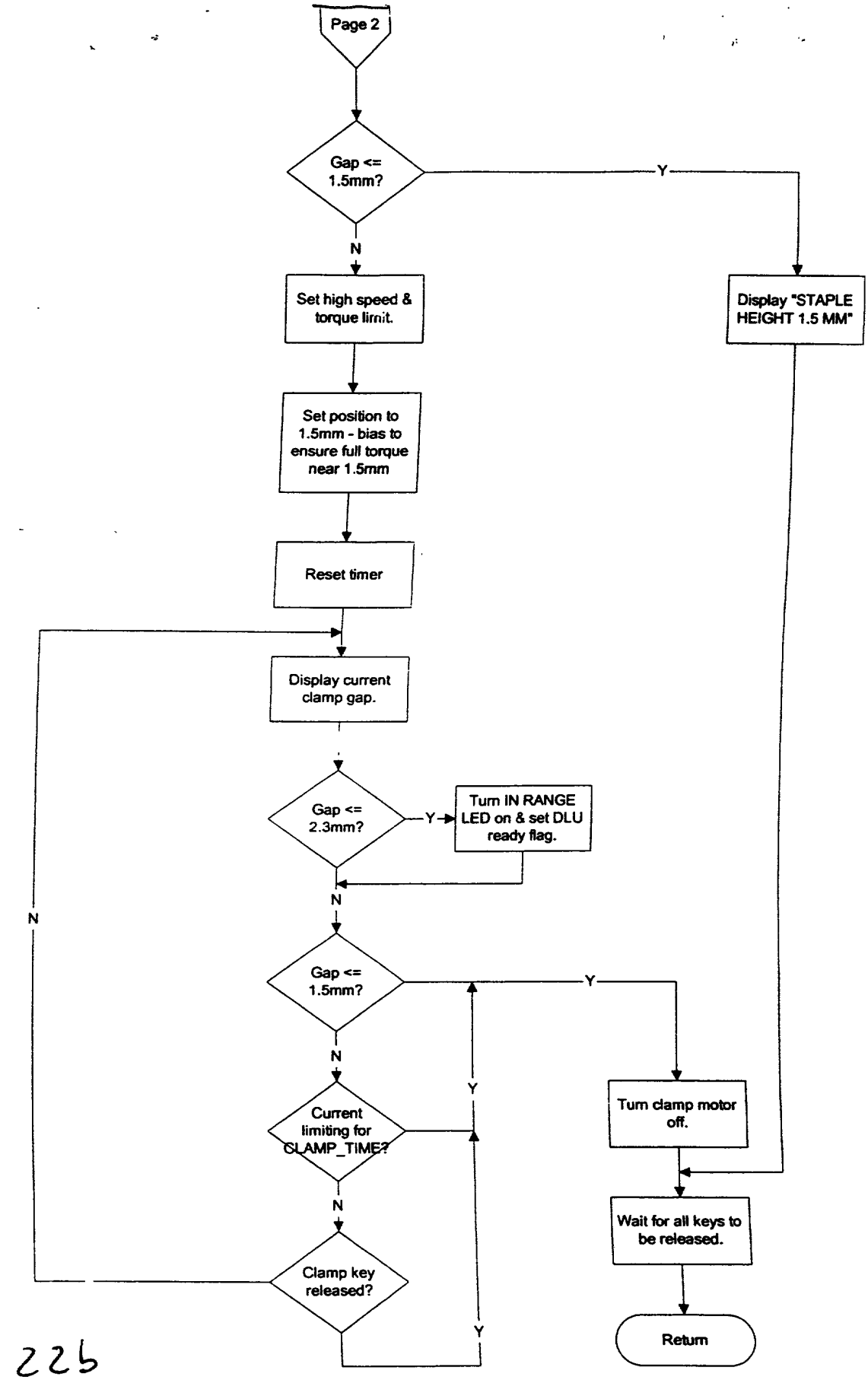
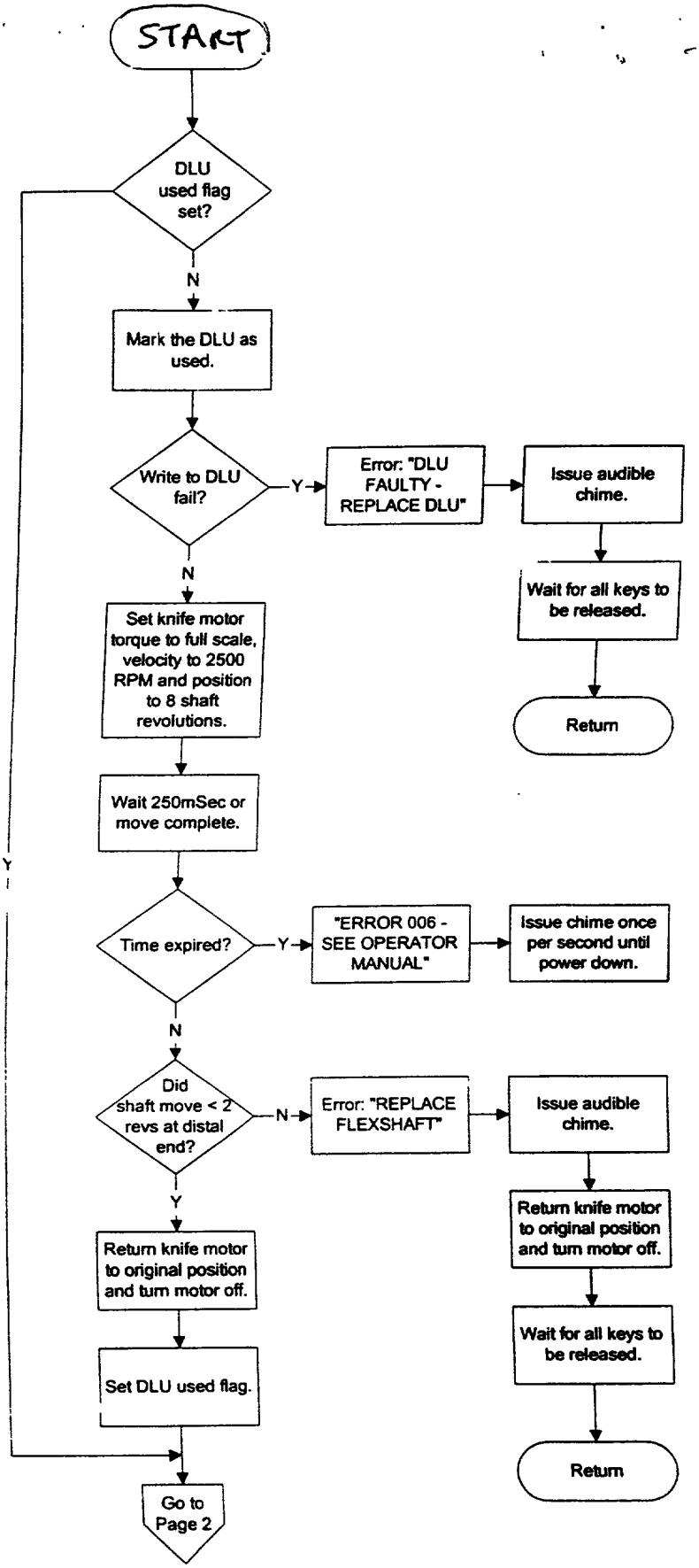

Page 2
Gap <= 1.5mm?
Y
N
Set high speed & torque limit.
Display "STAPLE HEIGHT 1.5 MM"
Set position to 1.5mm - bias to ensure full torque near 1.5mm
Reset timer
Display current clamp gap.
Gap <= 2.3mm?
Y
Turn IN RANGE LED on & set DLU ready flag.
N
N
Gap <= 1.5mm?
Y
N
Current limiting for CLAMP_TIME?
Y
N
Clamp key released?
Y
Turn clamp motor off.
Wait for all keys to be released.
Return

FIG. 22b



*The kernel tries 3x w/ 100mS time between tries to write DLU.

Fig. 23a

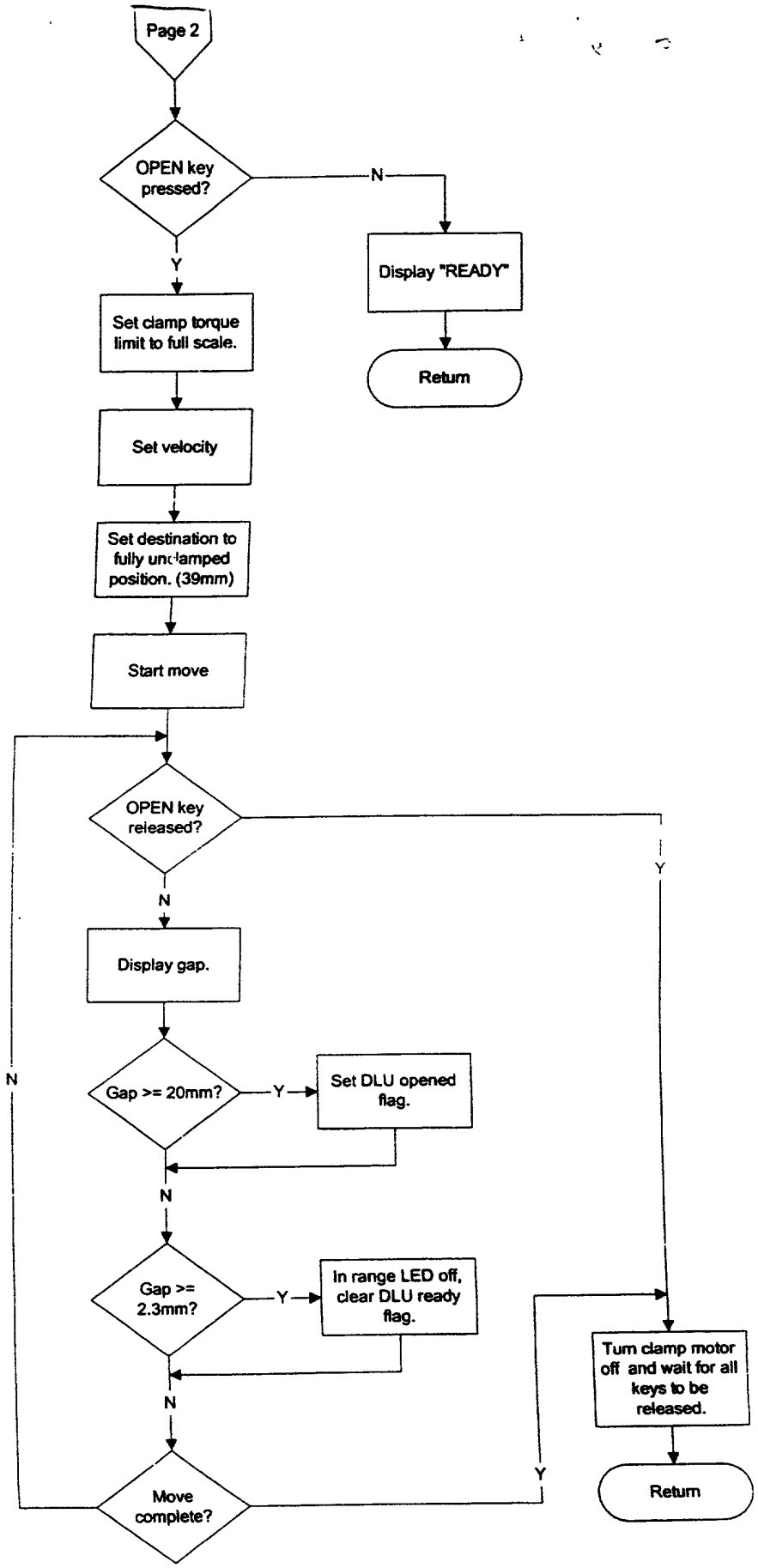

Page 2
OPEN key pressed?
N
Y
Display "READY"
Return
Set clamp torque limit to full scale.
Set velocity
Set destination to fully unclamped position. (39mm)
Start move
OPEN key released?
Y
N
Display gap.
Gap >= 20mm?
Y
Set DLU opened flag.
N
Gap >= 2.3mm?
Y
In range LED off, clear DLU ready flag.
N
Move complete?
Y
N
Turn clamp motor off and wait for all keys to be released.
Return

Fig. 23b

Figure 24a

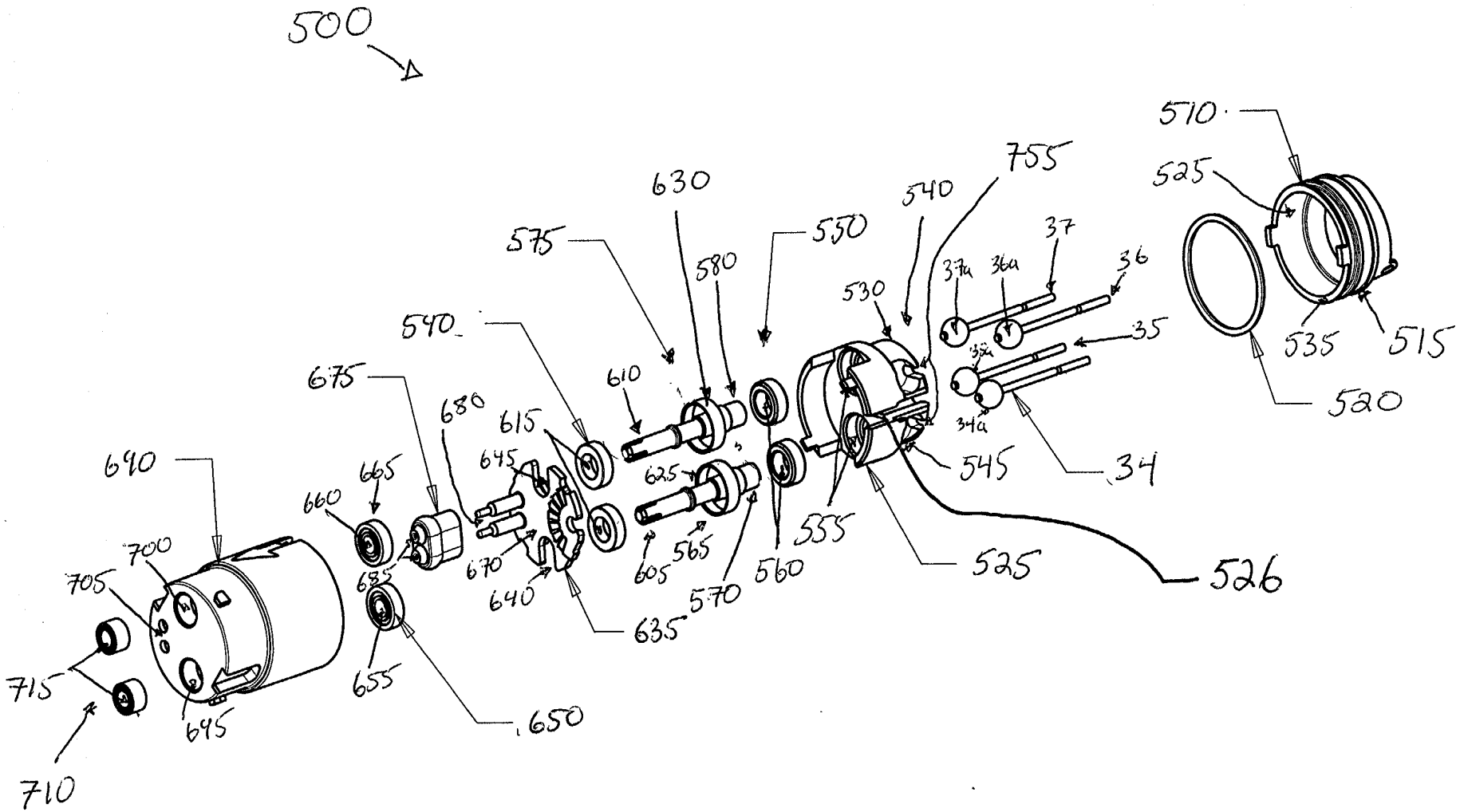

500
510
525
515
535
520
755
630
540
575
550
580
530
37
37a
36a
36
35
35a
34a
34
540
675
680
610
615
645
625
690
665
660
700
705
635
670
640
605
565
570
560
555
545
525
526
715
655
650
710

Figure 24b

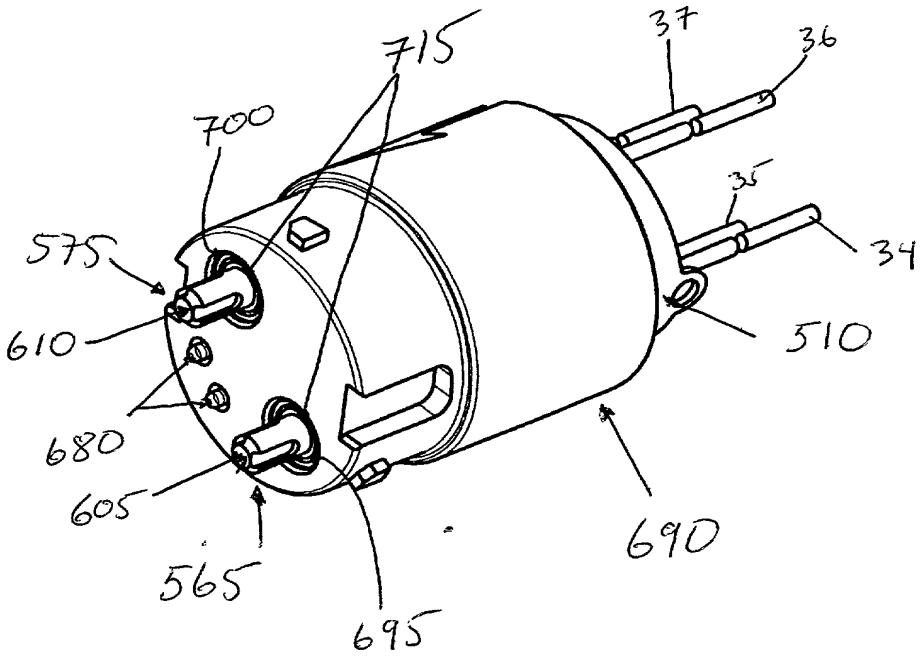


Figure 25

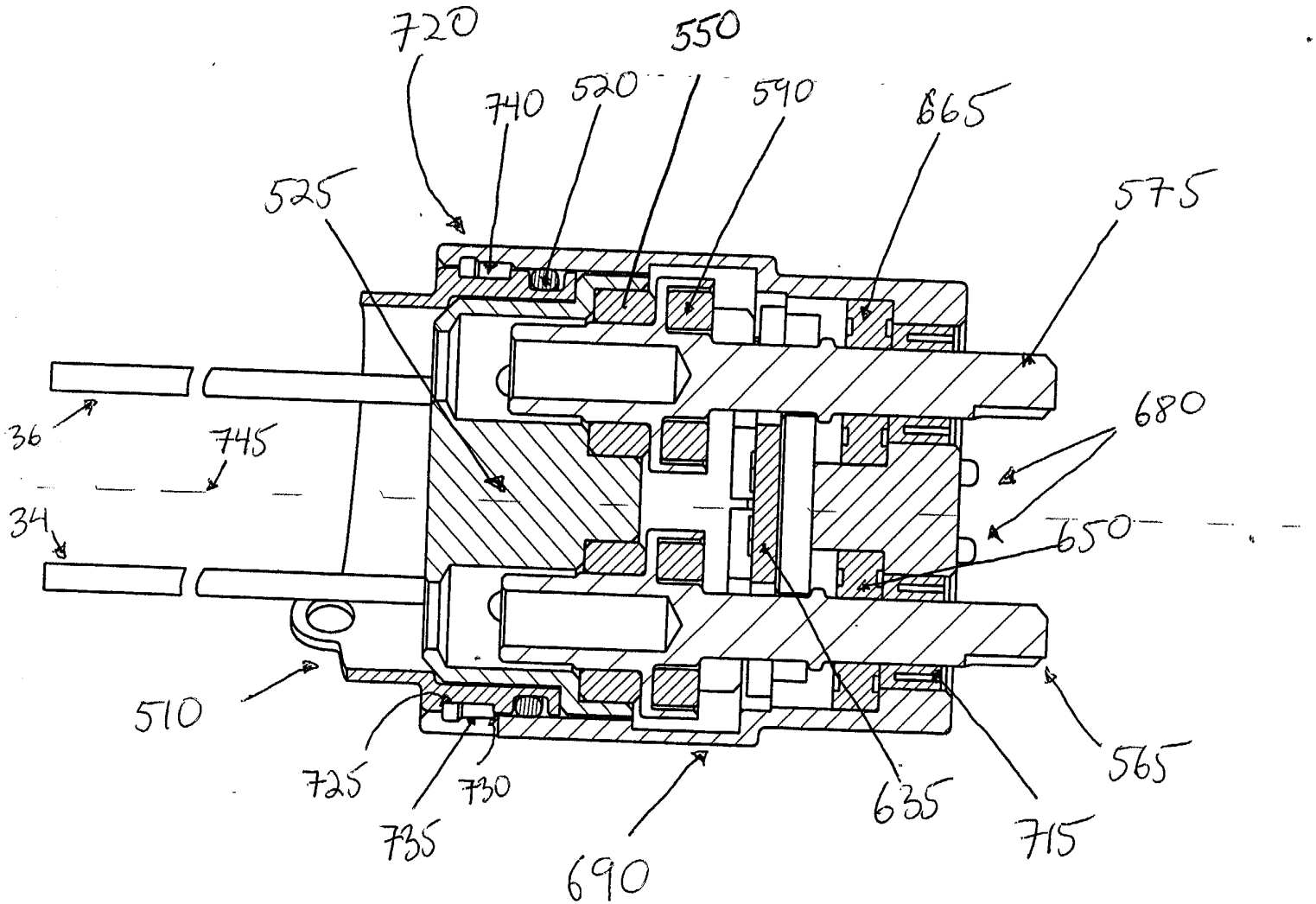

720
550
740
520
590
665
525
575
36
745
680
34
650
510
725
730
635
565
735
715
690

Figure 26a

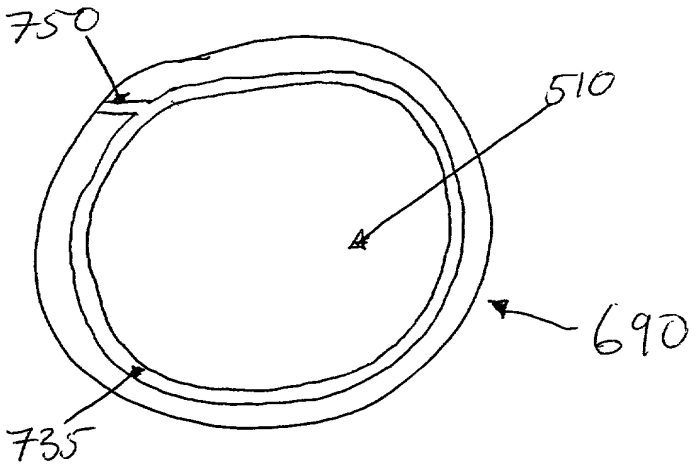


Figure 26b

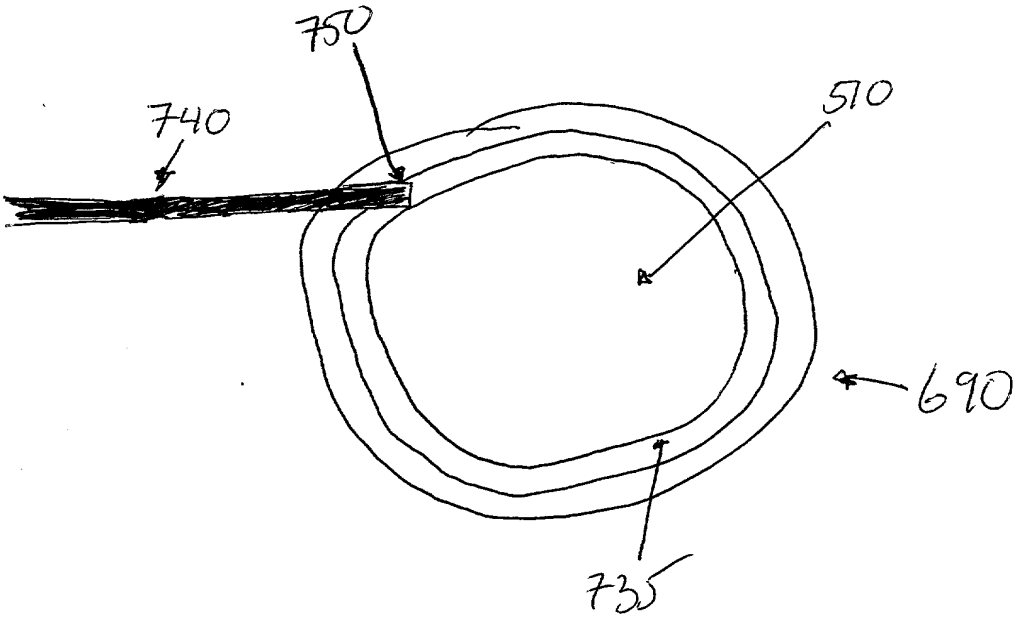


Figure 26c

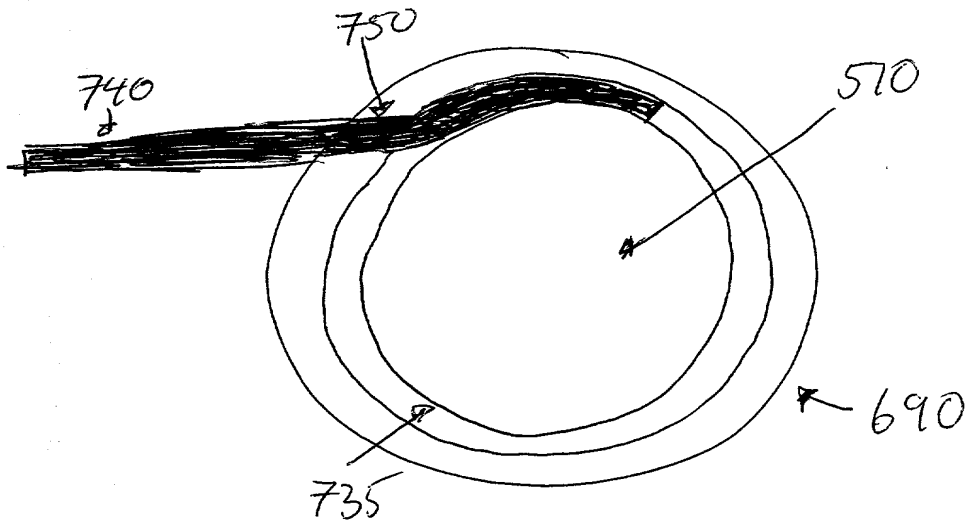


Figure 26d

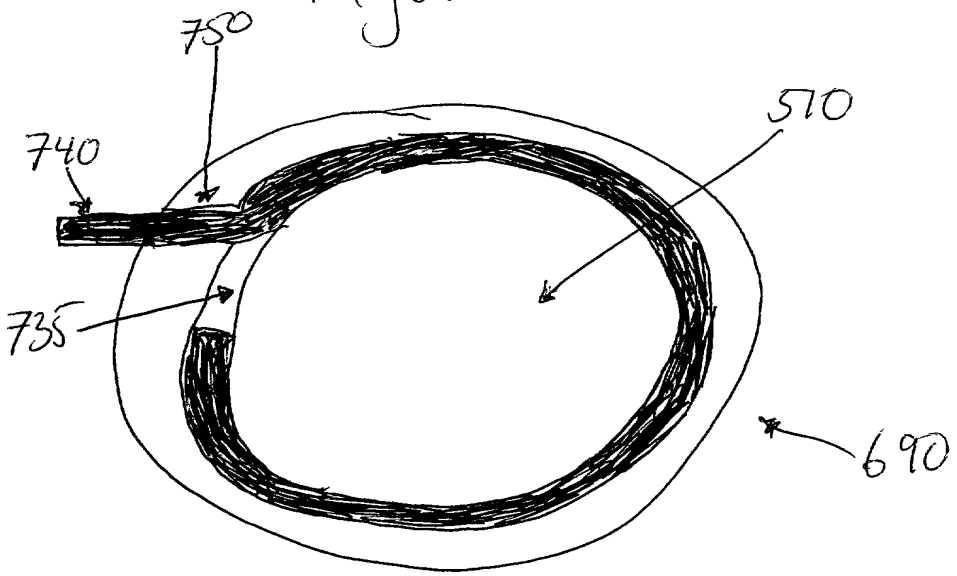


Figure 27

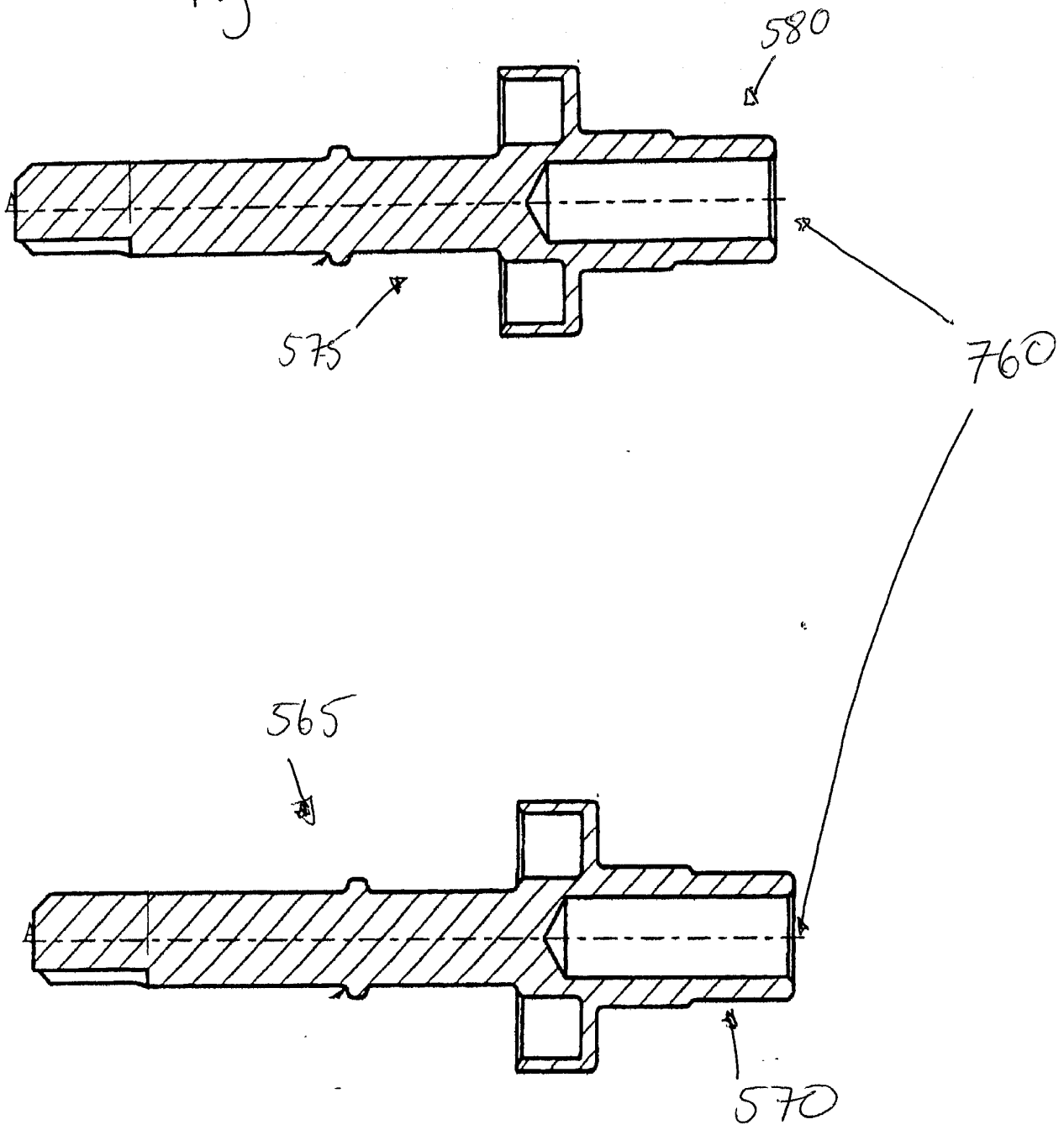


Figure 28a

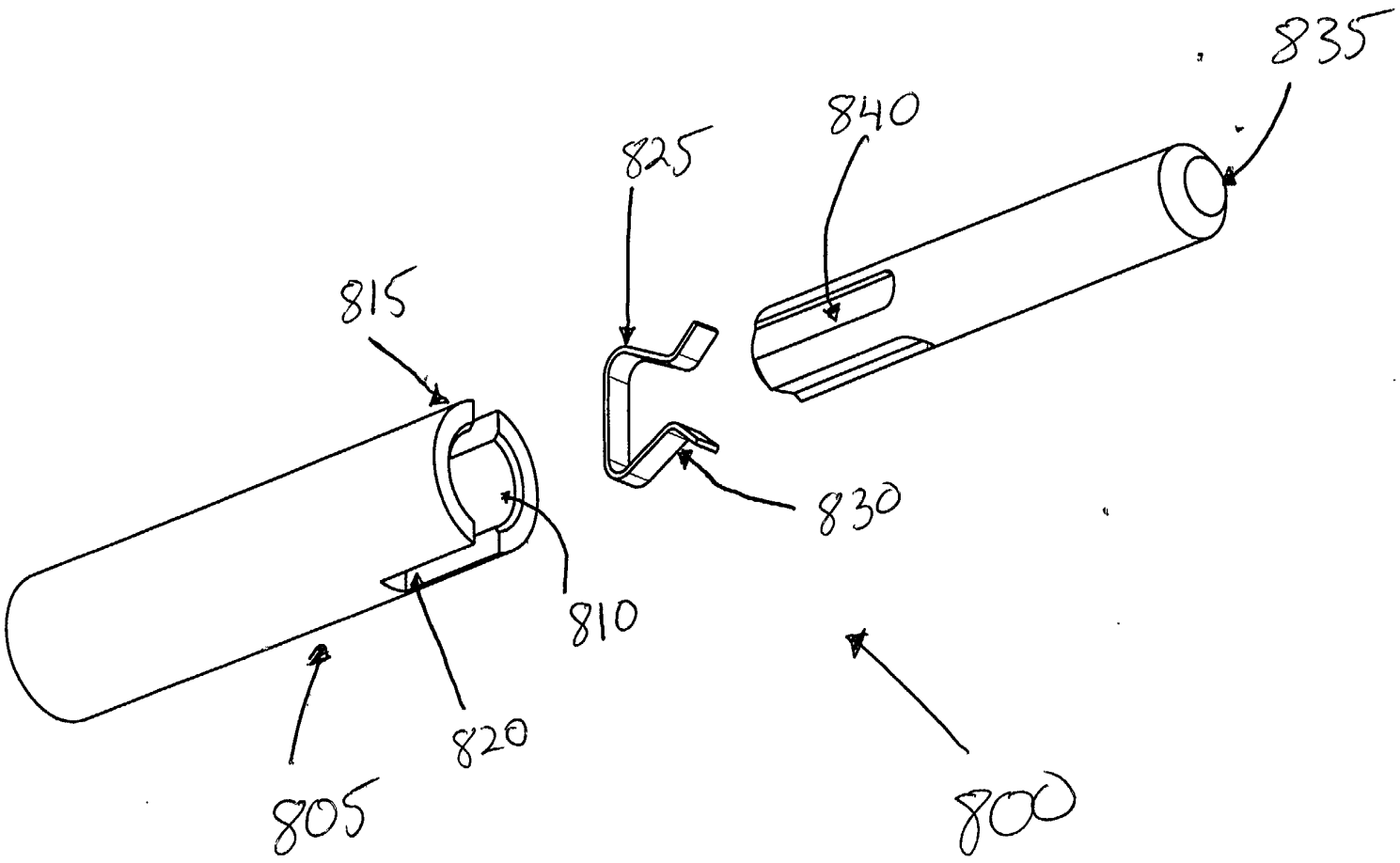


Figure 28b

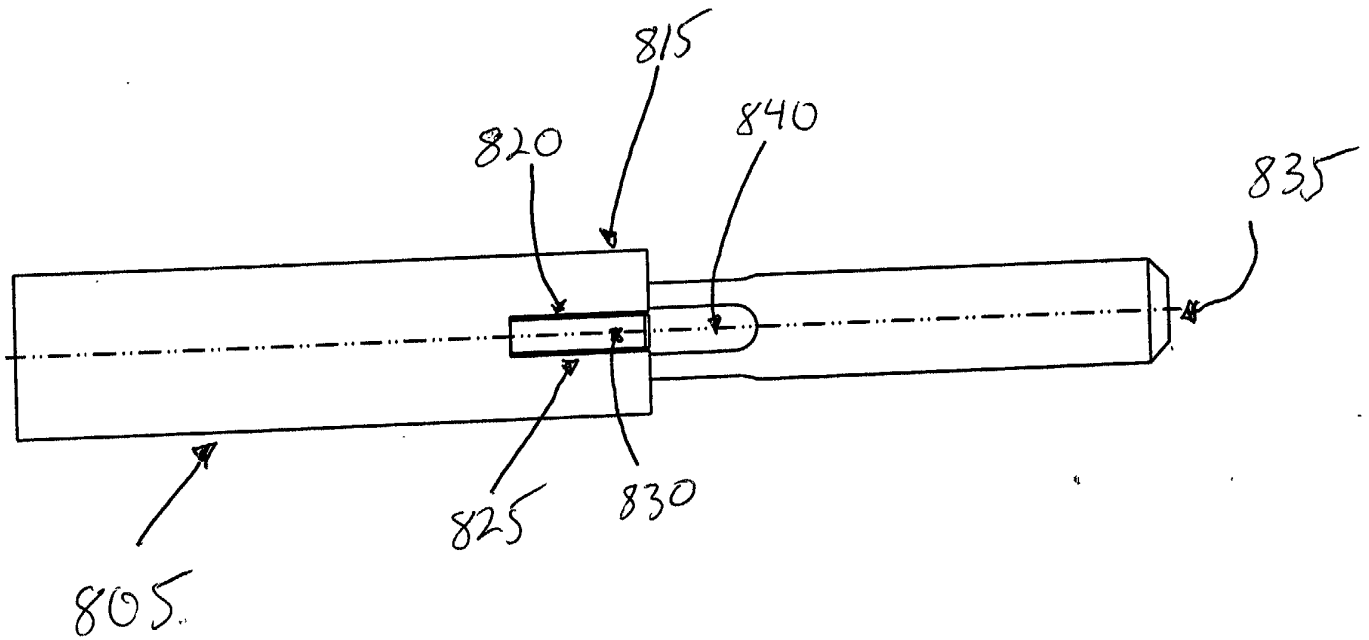


Figure 28C

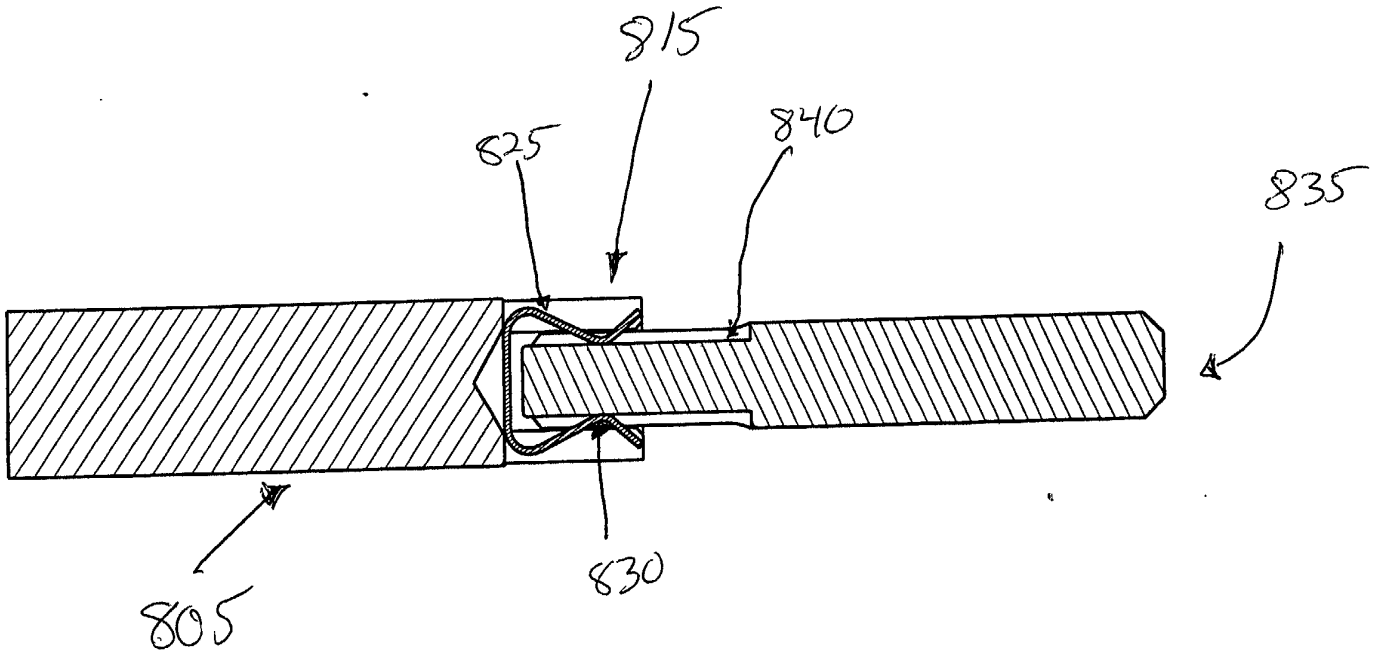


Figure 29

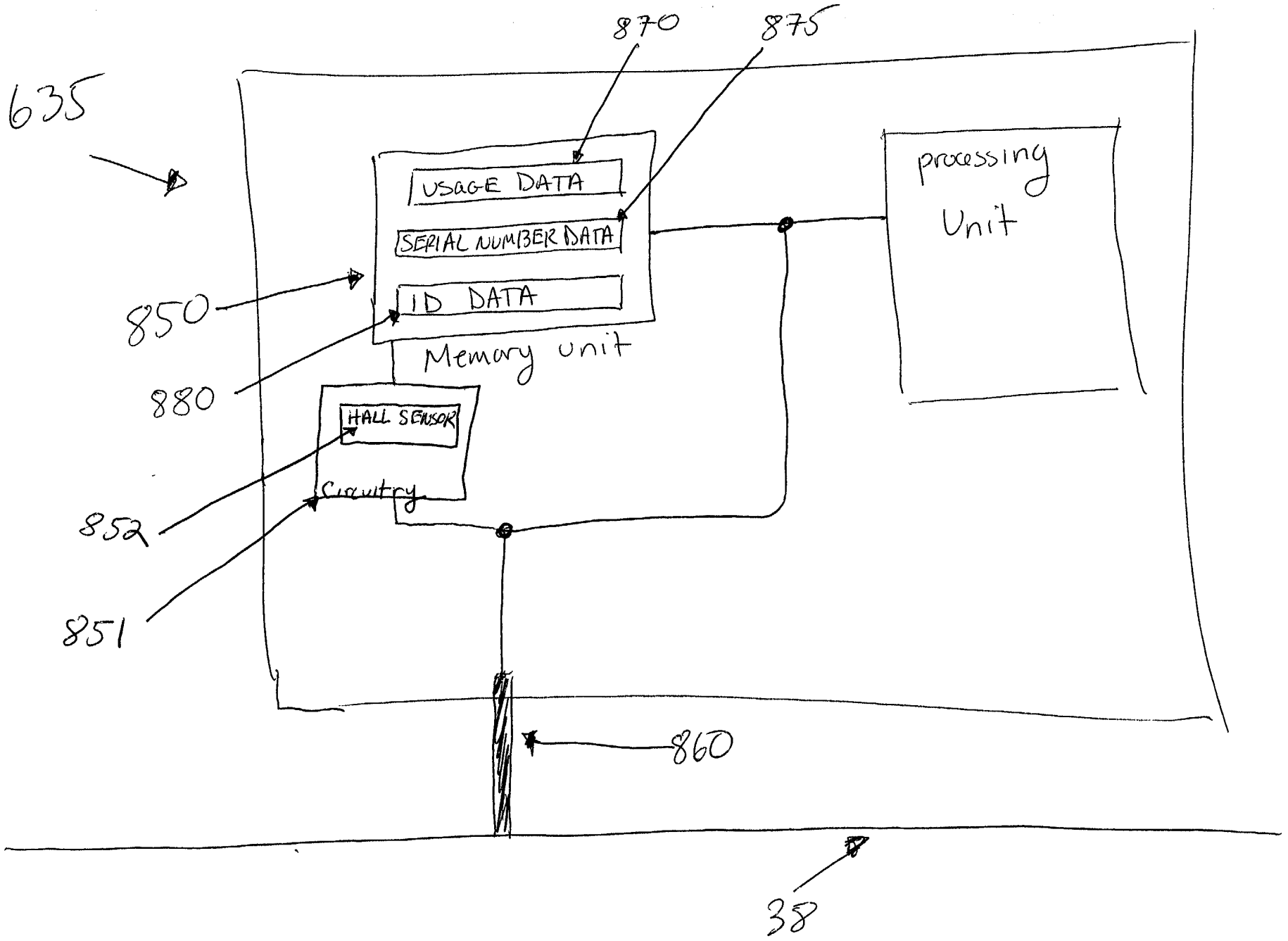

635
870
875
USAGE DATA
SERIAL NUMBER DATA
ID DATA
Memory unit
processing Unit
850
880
HALL SENSOR
Circuitry
852
851
860
38

Figure 30a

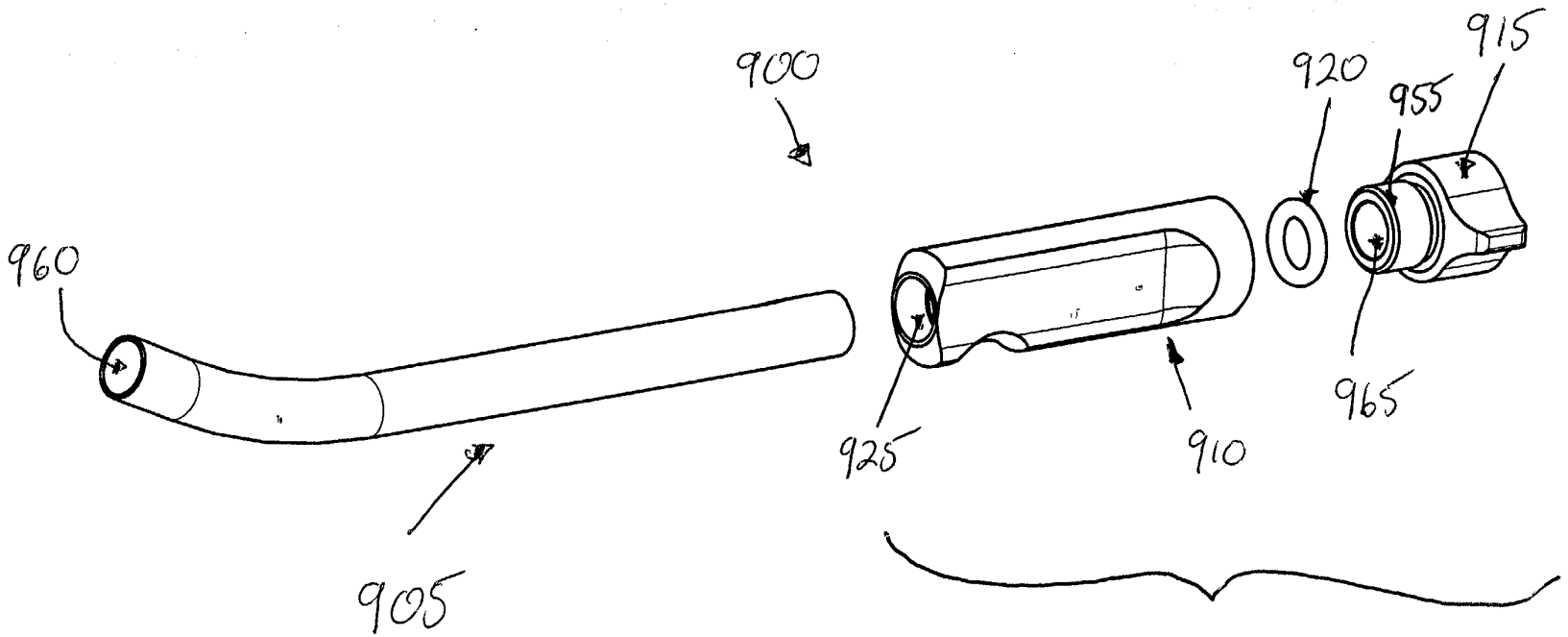


Figure 3Db

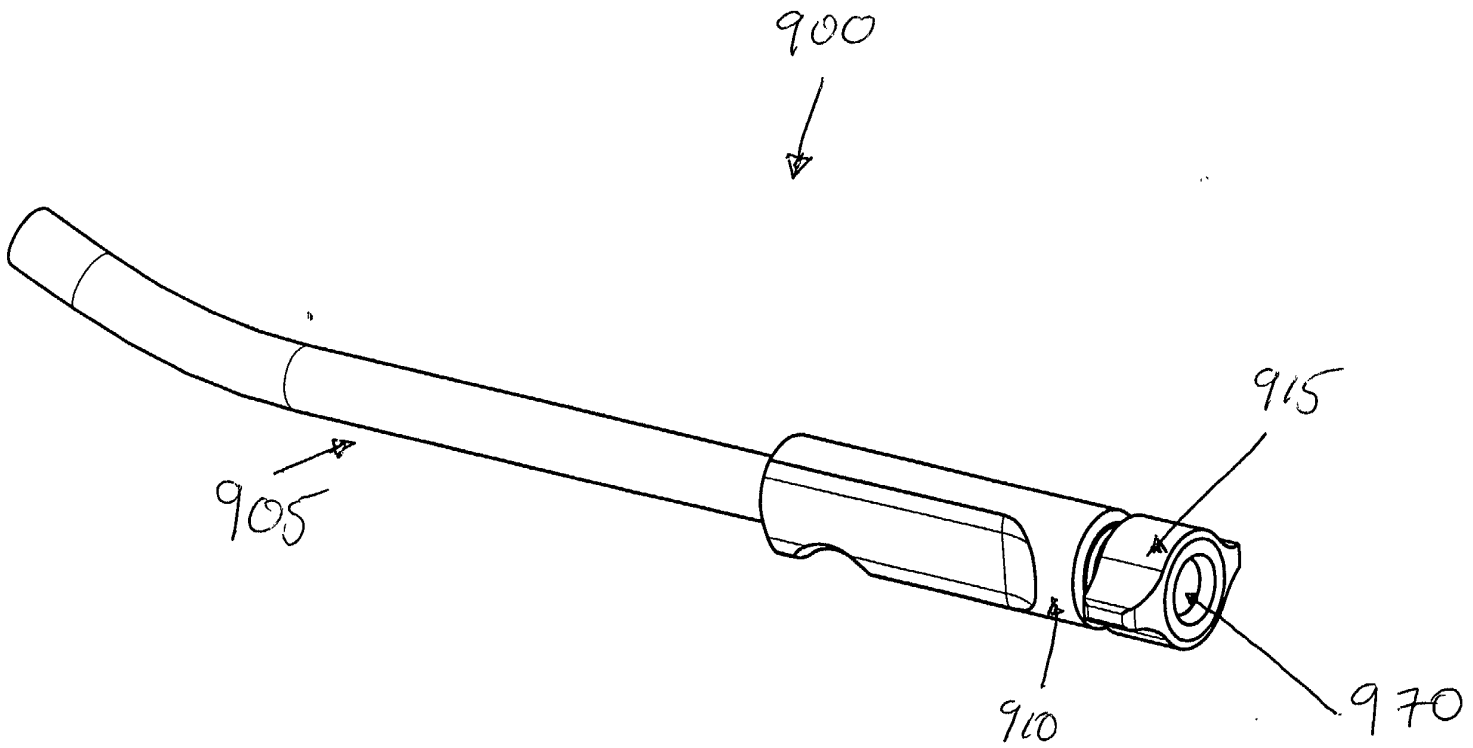


Figure 30C

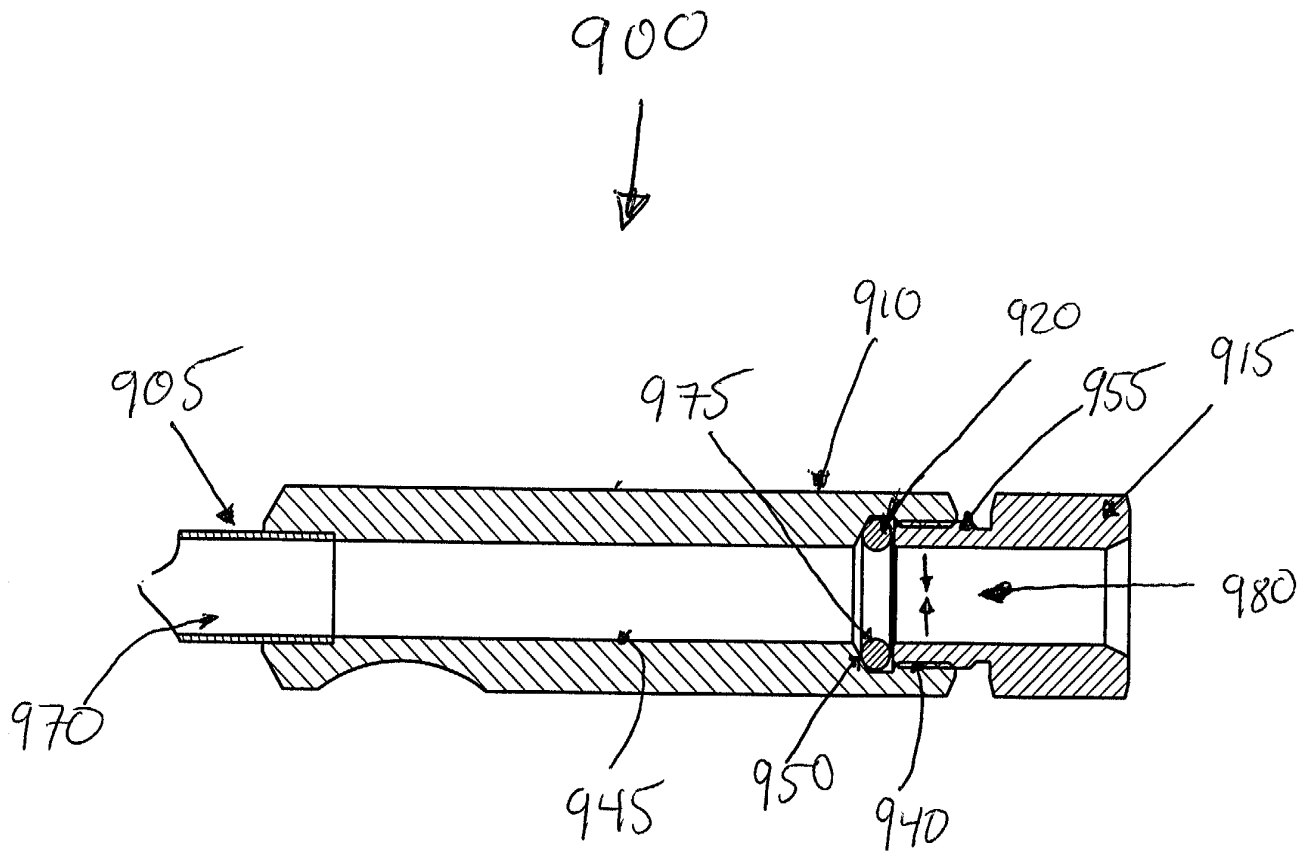


Figure 3T

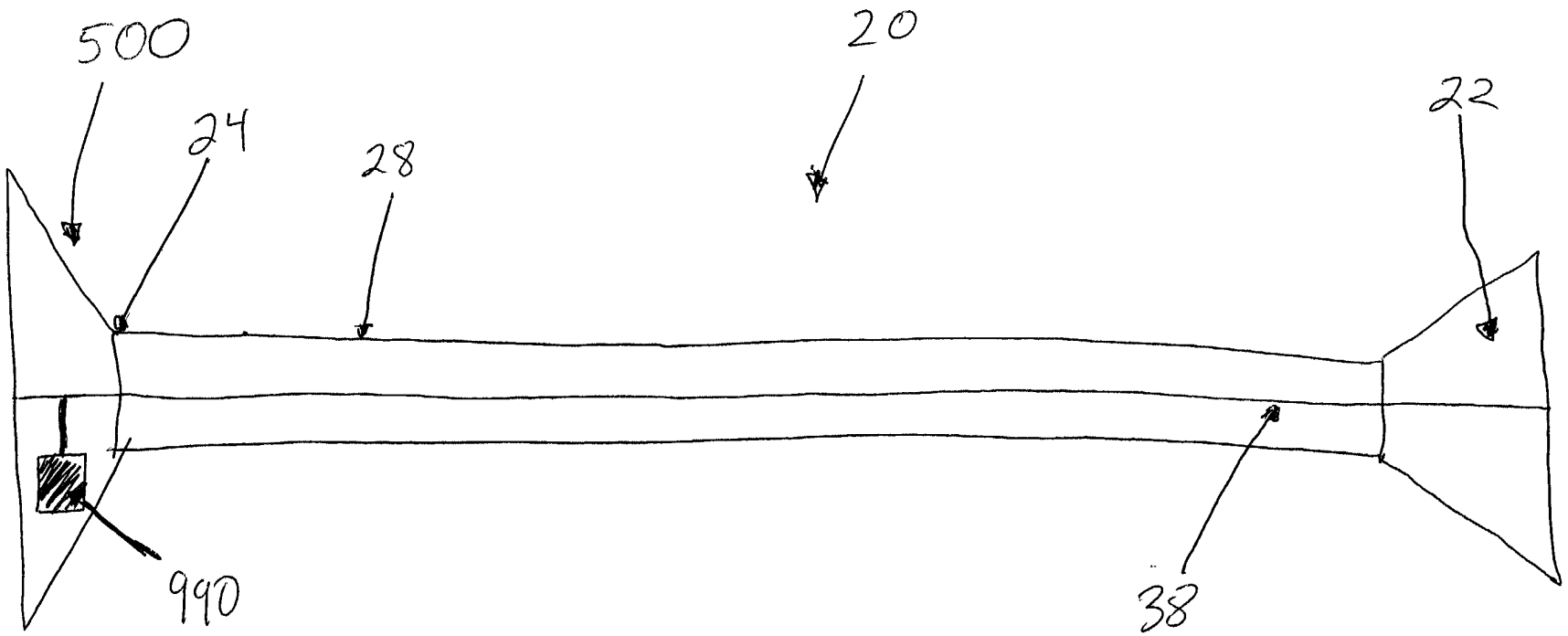
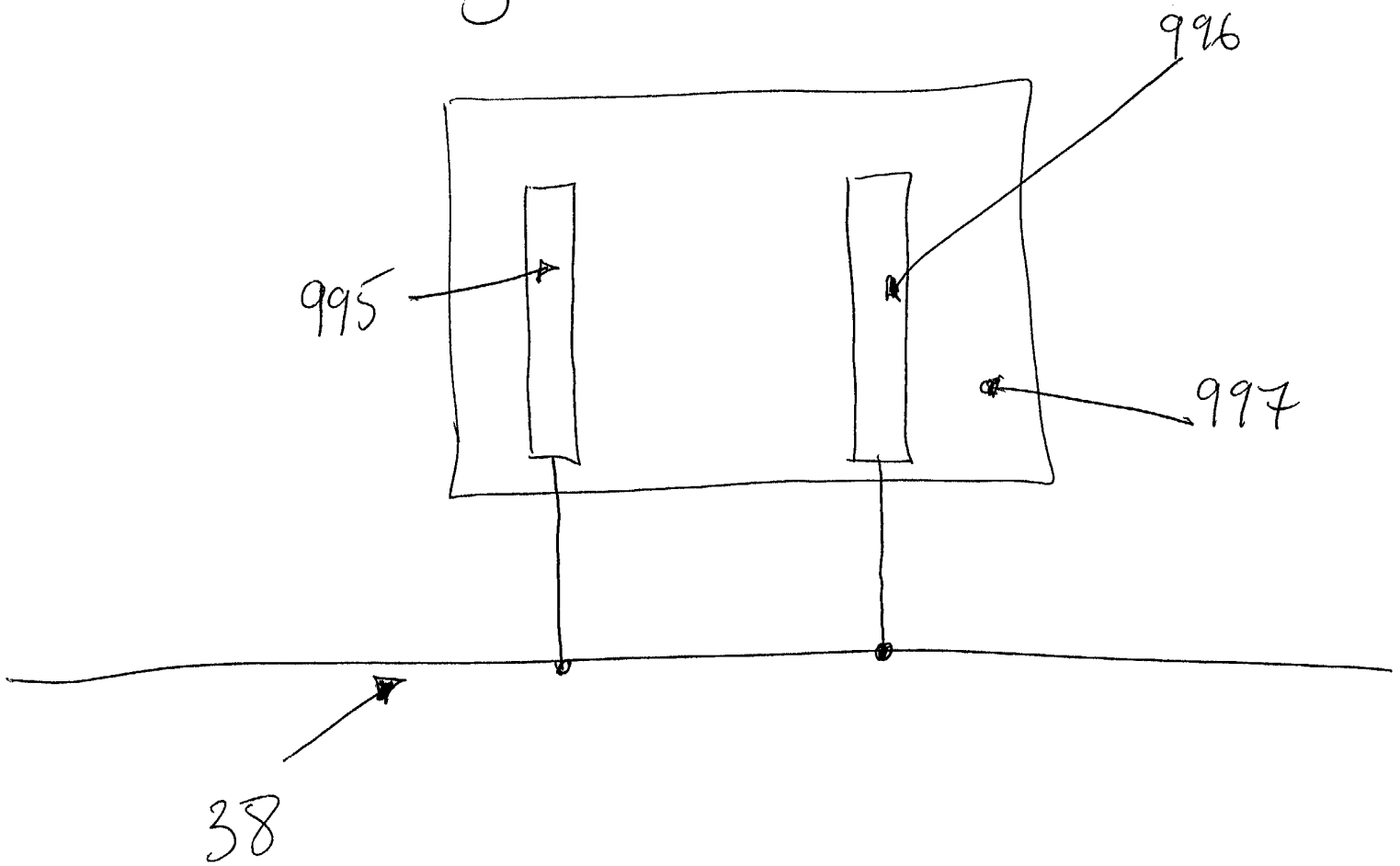



Figure 32